The University of Fiji
(An Entity of Arya Pratinidhi Sabha of Fiji)

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2023 Fiscal Review Committee

Get involved. Share your views on how Government manages its money.

The Minister of Finance has appointed the 2023 Fiscal Review Committee. Its Terms of Reference are to review:

- the existing tax and customs system as a whole (including current tax concessions) and its ability to generate the revenue Government needs within acceptable parameters to avoid over-taxation;
- Government policies which have positive and negative impacts on economic growth;
- current non-tax revenue policies, including their effectiveness in cost-recovery terms;
- the level and composition of public sector expenditure, the fiscal deficit, and public debt; and
- Government's medium-term strategies as espoused in the Medium-Term Fiscal Framework (MTFF) released in February.

The Committee must report back to the Government **by 10 May 2023**, with its recommendations on:

1. optimizing the tax and customs revenue base and simplifying the tax regime to improve compliance and collection of tax arrears;
2. removing regulatory impediments to economic growth, including distortions in the tax system and policies to promote investment and economic growth;
3. ensuring non-tax revenues properly recover Government costs;
4. reducing public sector wage costs and better managing and ensuring value for money on all operational expenditures;
5. ensuring better investment appraisal and project selection for new capital projects, and ensuring value for money on all capital expenditures; and
6. ensuring that recommended policies minimize economic and social impacts on Fiji's most economically vulnerable and disadvantaged citizens.

Hearing from you

We want to hear from citizens, businesses, civil society and industry groups. Time is limited so written submissions are preferred where possible.

Please email written submissions to fijifiscalreview2023@gmail.com by **5 April 2023**

Committee members will be travelling to the major urban centres on **29-31 March 2023**. We will advertise these as soon as arrangements are made.

Committee Members

The members of the Committee are: Richard Naidu (Chair), Lisa Apted (Deputy chair), Reaaz Ali, Vani Catanisiga, Edwin Chand, Neelesh Gounder, Matelita Katamotu, Fantasha Lockington, Kirti Patel, Pradeep Patel, Naibuka Saune, Viliame Takayawa, Barry Whiteside and Mereia Volavola.

REPUBLIC OF FIJI

MEDIUM TERM FISCAL STRATEGY 2024-2026

Ministry of Finance, Strategic Planning, National Development and Statistics

17 February 2023

PARLIAMENTARY PAPER NO. 7 OF 2023

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1.0 BACKGROUND

1.1 Section 12 (2) of the Financial Management (Amendment) Act 2021 ('**FMA 2021**') requires the Minister responsible for finance to submit a medium-term fiscal strategy to Cabinet for approval before the annual budget. Following Cabinet endorsement, the Minister must table the fiscal strategy in Parliament.

1.2 This medium-term fiscal strategy covering the period FY2023-2024 to FY2025-2026 is a critical one as there is an urgent need to address the high public debt situation which is a great concern for the Coalition Government. As such, the overriding objective of the medium-term fiscal strategy is to bring back fiscal discipline. Government will have to cut on wastages and ensure a return to fiscal sustainability. However, Government needs to strike a delicate balance between ensuring fiscal sustainability and having the flexibility to manoeuvre fiscal policy to support economic growth and inclusive development.

1.3 Fiscal consolidation is at the heart of this medium-term fiscal strategy by the Coalition Government. This has to be supported by revenue reforms guided by the principles of fairness, simplicity and revenue adequacy and complemented by a major restraint on overall public expenditures, including reprioritisation of fiscal resources to better achieve our socio-economic and other development goals.

1.4 Apart from fiscal consolidation, a private sector led economic rejuvenation is also an important pillar to ensure sustainable economic growth which is critical to put the debt to GDP ratio on a consistent downward path, complementing the planned fiscal deficit reductions. However, this requires a number of structural reforms to ensure private sector growth and development is supported.

1.5 The overall fiscal strategy includes the medium-term fiscal framework, with measurable fiscal objectives and targets to guide the preparation of the FY2023-2024 Budget and beyond. It also provides broad guidelines for expenditure & revenue policy formulation, debt management and the timelines for the preparation of the upcoming Budget.

1.6 The formulation of the fiscal strategy is guided by the principles of responsible fiscal management in line with Section 5 of the FMA 2021 which includes, accountability, comprehensiveness, fiscal discipline, specificity, sustainability, transparency and value for money. The information contained in this document is based on the latest available data as of 31 December 2022.

1.7 Section 2.0 provides an overview of the economic performance and outlook and risks while section 3.0 reviews the fiscal performance for the last budget and previous years. Section 4.0 outlines the objectives of the medium-term fiscal strategy and the medium-term fiscal framework for the next three fiscal years.

2.0 ECONOMIC PERFORMANCE AND OUTLOOK

International and Domestic Economy

2.1 The medium-term fiscal strategy is set against the backdrop of a looming global recession and a domestic economy which is recovering from three consecutive years of decline, including the largest ever economic contraction of over 17.0 percent in 2020. Despite a strong rebound in 2022, the domestic economy will not return to pre pandemic levels by 2024. It is important to take into considerations these economic conditions now and moving forward as it has direct and indirect implications on the overall design and execution of the medium-term fiscal strategy.

2.2 On the global front, the International Monetary Fund ('**IMF**') in its January 2022 World Economic Outlook had estimated global growth to slow down from 6.2 percent in 2021 to 3.4 percent in 2022 and weaken further to 2.9 percent in 2023. Similarly, the World Bank has downgraded its global growth projection for 2023 to 1.7 percent, from its previous estimate of 3.0 percent.

2.3 The downward revision reflects synchronized monetary policy tightening in developed economies to tame inflation, tightening financial conditions, growing geopolitical tensions and the ongoing spillover effects of the Russia Ukraine conflict. Moreover, the US and the Euro area are undergoing simultaneous weakening, and the resulting spillovers are exacerbating other headwinds faced by emerging market and developing economies. The near-term outlook is marred by persistent inflation (particularly for food and energy), escalating geopolitical tensions and the ongoing climate crisis.

2.4 On the domestic front, the Fijian economy showed strong recovery with an estimated 15.6 percent GDP growth in 2022 after experiencing three consecutive years of decline. The broad-based recovery was underpinned by the services sector largely driven by better-than-expected rebound in tourism and related sectors. Other sectors that have contributed positively to the growth include transport, wholesale & retail, administrative & support services, manufacturing, finance, agriculture, and improved net tax collections during the year.

2.5 Given that tourism accounts for roughly 40 percent of GDP, a quick tourism recovery is critical for our wider recovery prospects. Better-than-expected rebound in visitor arrivals in 2022 suggests that last year's growth estimate is slightly upward biased. In 2022, visitor arrivals totalled 636,312 about 71 percent of pre-pandemic levels with relatively higher yields supporting strong growth in tourism earnings. Based on current trends and encouraging feedback from industry stakeholders, visitor arrivals are projected to reach 760,231 or 85 percent of pre-pandemic levels by 2023, with a full return to pre-pandemic levels by 2024. A further growth of 3.0 percent is projected for 2025.

2.6 With the projected recovery in tourism and related sectors in the medium term, a broad-based growth of 6.0 percent is forecast for 2023, followed by 3.8 percent in 2024 and 2.4 percent in 2025. However, downside risks to these forecasts have increased with the impending global recession and subsequent slowdown in Fiji's major tourism source markets.

Investment and Consumption Activity

2.7 Consumption spending has been strong in 2022 as reflected by strong PAYE, domestic and import VAT collections, with Net VAT collections recovering to near-2019 levels. Latest partial indicators of consumption such as PAYE collections (+16.6%), net VAT collections (+90.3%), new consumption lending (+37.9%), vehicle registrations (+24.4%), and electricity consumption (+15.8%) also show strong annual gains up to November 2022.

2.8 Consumption spending has also been supported by the strong growth in remittances in the year to December (+23.1%) supported by greater participation of Fijian workers in international labour market schemes, and the rollout of inflation mitigation transfers by Government to low-income families. Remittances receipts account for the second largest source of foreign exchange and has crossed the billion-dollar mark in 2023.

2.9 The labour market remained resilient and strengthened throughout 2022, largely supported by higher recruitment intentions in the tourism-related sectors. The number of jobs advertised was higher by a massive 153.8 percent in the year to November, while formal sector employment returned to over 90 percent of comparable pre-pandemic levels. Just over 17,000 people have moved abroad up to the third quarter, with a majority leaving for employment purposes (12,852), of which 2,482 Fijians left under the various seasonal employment schemes to Australia and New Zealand while the remainder emigrated (4,153).

2.10 Forward-looking construction indicators such as value of building permits issued, and domestic cement sales (+33.2 percent) cumulative to September point to an increase in investment activity. Despite this, investment and construction activity remain hampered by high building material prices. On an annual basis, the Building Material Price Index (BMPI) show that building material prices have grown by more than 5.0 percent, on average, in both the June and September quarters of 2022. Moreover, there has been a slowdown in the issuance of completion certificates and the value-of-work-put-in-place in June, while new investment lending by banks rose by 26.2 percent in the year to November. In 2023, investment is expected to remain modest consistent with global and domestic developments.

Inflation

2.11 Fiji's annual average inflation stood at 4.3 percent in 2022, led primarily by imported inflation due to higher global food, and fuel, prices. Domestic inflation remained relatively stable mostly owing to policy actions by Government such as zero-rated VAT on basic household consumables and stricter monitoring of prices and other price control measures. In 2023, inflation is forecast at 3.0 percent with significant upside risks. The synchronized tightening of monetary policy around the globe, coupled with subdued global demand, has helped put downward pressure on global commodity prices lately, although they remain well above pre-pandemic levels.

2.12 Risks to the outlook include the direct and indirect impacts of the prolonged conflict in Ukraine; the growing tensions between China and Taiwan; spillovers from the monetary tightening in advanced economies; the appreciation of the U.S. Dollar, persistently high global and domestic inflation; and the onset of the cyclone season in Fiji.

Foreign Reserves, Monetary Policy and Financial Sector

2.13 Foreign reserves remained comfortable at around $3.4 billion at the end of December (equivalent to 6.9 months of retained import cover) bolstered by high tourism receipts, remittances, and earlier external Government loan drawdowns and budget support from Australia and New Zealand. Foreign reserves are expected to remain adequate in the near to medium-term, however, proactive measures are needed to address Fiji's underlying balance of payment challenges. Domestic exports must be sustainably increased, new foreign direct investment enticed, and the tourism sector rebuilt and diversified. More urgently, productivity improvements are needed across the economy to enhance our competitiveness and long-term economic growth prospects.

2.14 Financial sector conditions reflected the on-going recovery in the real sector last year. Private sector credit continued its annual ascent for the eleventh straight month in November (+7.0%), while new loans by both commercial banks and licenced credit institutions grew by 57.1 percent and 81.2 percent, respectively, in the same span. Liquidity in the banking system remains all time high at $2,413.5 million (as of 30 December) while outstanding deposit and lending rates have generally trended downwards.

2.15 The RBF is pursuing an accommodative monetary policy stance by maintaining its Overnight Policy Rate at 0.25 percent. This will continue to play an important role in our post-pandemic recovery.

Domestic Outlook and Risks

2.16 While the recovery in the domestic economy has been strong, there are a number of risks that has to be managed carefully in the immediate to medium term. The economy is forecast to expand by 6.0 percent in 2023 and another 3.8 percent in 2024 when it rebounds to the same level of real GDP as in 2019. Although a broad-based growth is expected over the next two years, the main catalyst will still be the rebound in tourism activity as it gradually returns to the pre-pandemic level by 2024.

2.17 However, sustaining tourism and overall economic growth beyond 2024 will prove challenging. Fiji had benefited from the "first mover advantage" in 2022 due to a higher vaccination rate and earlier opening of borders relative to competitor countries, although these benefits are expected to wane throughout this year.

2.18 In the two years before the pandemic, there was a consecutive slowdown in the growth of visitor arrivals owing to high taxation and the rising cost of holidaying in Fiji. Whilst some of these issues have been subsequently dealt with through a reduction in tourism-related taxes and duties, the current high inflationary environment has eroded these benefits.

2.19 Therefore, Fiji remains vulnerable to price competition from South-East Asian destinations where cost structures are lower. The tourism industry needs to position itself as a high-quality destination and attract high-yielding guests to create a differentiated market from South-East Asia and possibly other Pacific destinations with a greater focus on staycation packages, sports, eco-tourism and business & conference markets. From a policy perspective, continued and sustainable growth post-2024 requires structural reforms that support a private sector and export-led growth.

2.20 Secondly, the broad-based deceleration in the global economy and monetary policy tightening across most of the globe will bring in additional challenges. The recent global growth projection of below 2.0 percent by the World Bank suggests that the global economy is headed for a recession unless supply side disruptions and labour market tightness dissipate. A global recession will have flow on effects on the domestic economy.

2.21 The ongoing geopolitical tensions led by the Russian invasion of Ukraine indicate that inflationary pressures could persist. According to the IMF, the global economic slowdown has failed to arrest inflationary pressures. Global inflation peaked at 9.5 percent last year and is expected to decelerate to 4.1 percent by 2024. Core inflation is also rising globally, and price pressures are now spilling over from food and energy. These global price developments are expected to pass through to Fiji and keep inflation relatively elevated this year, albeit lower than last year and may warrant a continuation of fiscal support for the poor and vulnerable.

2.22 Finally, Fiji is currently in the cyclone season, and we need to watch out for any major natural disaster which will have impact on the infrastructure, economy, livelihoods and lives of Fijians.

3.0 FISCAL POLICY DEVELOPMENTS

3.1 Government managed to maintain the debt ratio within internationally accepted benchmark of around 45 percent of GDP prior to 2016. However, since then overall public expenditures grew strongly at an unsustainable rate leading to a spike in debt levels. The COVID-19 pandemic exposed these fiscal vulnerabilities and made the debt situation even worse.

3.2 While the large reconstruction works post TC Winston and other natural disasters demanded substantial fiscal outlays, growth in expenditures was also attributed to increases in the public sector wage bill, higher transfers to off-budget entities like the Fiji Roads Authority and Water Authority of Fiji, large capital investments in public buildings and schools, large social sector spending and increased funding for a wide range of new expenditure initiatives over the years.

3.3 In light of this, Government embarked on a short-lived medium-term fiscal consolidation in the FY2019-2020 Budget. The focus was put on increasing revenues, reducing fiscal deficits by controlling expenditures, and to build fiscal buffers to respond to future shocks. However, Government's fiscal consolidation plans were cut short due to the dual shocks of the COVID-19 pandemic and a series of natural disasters (TC Harold, TC Yasa and TC Ana) which had devastating impact on the Fijian economy, jobs, public finance and socio-economic conditions.

3.4 With the onset of the COVID-19 pandemic in early 2020, countries around the globe closed borders and imposed travel restrictions. Consequently, activity in Fiji's tourism and related sectors ground to a halt and private sector confidence deteriorated significantly. As such, fiscal policy had to be re-calibrated, and a large counter cyclical fiscal response was implemented to keep the economy afloat and provide assistance to unemployed and vulnerable households with various income support measures.

Revenue

3.5 The COVID-19 stimulus package also included some major tax policy changes. These included removing Service Turnover Tax (STT), stamp duty, and Environment & Climate Adaptation Levy (ECAL). In addition, departure tax was halved (from $200 to $100), significant reduction in excise taxes on alcohol and notable decreases in fiscal duty and import excise rates across around 2,000 tariff lines of the Customs Tariff Act.

3.6 While such bold measures produced intended results to revive tourism, it resulted in a permanent loss in revenues of around 4 to 5 percentage points of GDP. Total tax to GDP ratio averaged 24 percent between 2014 to FY2019-2020 period and fell sharply to 15.4 percent in FY2020-2021 (**Table 1**). This reflected the combined impact of the economic contraction and the large tax cuts.

3.7 During the pandemic, Government finances were under immense pressure as monthly tax revenues declined by almost 50 percent on average with losses in tax revenues accumulating to over $2.6 billion in just two financial years.

3.8 Over the years, non-tax revenue has also played an important role in the revenue base. While core non-tax revenues have been generally stable, the relatively large budget support grants from Australia and New Zealand and other bilateral and multilateral partners as well as the divestment of Energy Fiji Limited shares helped sustain overall revenues during the COVID-19 period. Given the large decline in tax revenues, total Government revenues fell to 21.9 percent of GDP at the end of FY2021-2022 compared to 27.1 percent pre-COVID.

3.9 In the FY2022-2023 Budget, further changes to taxes were announced largely to address rising inflationary pressures and streamline taxes to bring about greater efficiency and recoup some of the lost revenues. For instance, the implementation of a three-tiered VAT structure (zero rated on 21 basic items, 15% on 21 non-essential items and 9% for remaining items) was engineered to provide relief to households, while corporate tax (for companies listed on South Pacific Stock Exchange) was aligned to 20 percent and the extremely generous film tax incentives were reduced.

Table 1: Fiscal Performance

($Million)	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023 Budget
Total Revenue	**3,244.4**	**3,180.5**	**2,717.1**	**2,143.1**	**2,190.9**	**2,939.9**
As a % of GDP	28.5	27.1	25.4	23.4	21.9	24.9
Tax Revenue	**2,831.6**	**2,819.7**	**2,193.8**	**1,412.7**	**1,692.0**	**2,322.1**
As a % of GDP	24.8	24.0	20.5	15.4	16.9	19.6
Non-tax Revenue	**412.8**	**360.8**	**523.3**	**730.4**	**498.9**	**617.8**
As a % of GDP	3.6	3.1	4.9	8.0	5.0	5.2
Expenditure	**3,742.7**	**3,600.1**	**3,353.4**	**3,190.4**	**3,414.1**	**3,812.1**
As a % of GDP	32.8	30.6	31.3	34.8	34.1	32.2
Operating Expenditure	**2,322.0**	**2,428.9**	**2,333.7**	**2,189.0**	**2,261.7**	**2,600.7**
As a % of GDP	20.4	20.7	21.8	23.9	22.6	22.0
Capital Expenditure	**1,383.2**	**1,133.1**	**988.1**	**973.4**	**1,123.0**	**1,160.6**
As a % of GDP	12.1	9.6	9.2	10.6	11.2	9.8
SEG 13 VAT	37.5	38.1	31.6	28.0	29.4	50.8
Overall balance	**-498.3**	**-419.6**	**-636.3**	**-1,047.3**	**-1,223.2**	**-872.2**
As a % of GDP	**-4.4**	**-3.6**	**-5.9**	**-11.4**	**-12.2**	**-7.4**
Nominal GDP	11,399.1	11,757.5	10,703.3	9,167.6	10,020.9	11,827.3

Expenditure

3.10 Government expenditure generally trended upwards after the 2014 elections, dipped slightly in FY2016-2017 but rose sharply by 22.3 percent in FY2017-2018. This was largely driven by higher investment spending, increased outlays in health and education sectors and significant disaster-related reconstruction spending. Moreover, introduction of social pension, disability allowance and bus fare support schemes also led to higher spending in the social sector and improved social safety nets.

3.11 Total expenditure as a percent of GDP averaged around 30.3 percent from 2014 to FY2016-2017 and increased to 32.8 percent in FY2017-2018. Government commenced an expenditure-driven consolidation in FY2019-2020 with a strong focus on improving operational efficiency and building fiscal buffers following the substantial reconstruction spending post TC Winston and the successive natural disasters in 2018. Total expenditure to GDP ratio fell slightly to 31.3 percent over the ensuing two years but recovered by over three percentage points in FY2020-2021 (34.8%) and FY2021-2022 (34.1%). The increase was largely unavoidable as expenditure demands for targeted unemployment support (over $500 million), and continuation of critical public services were prioritised. Social spending accounted for a significant fiscal injection totalling close to 5.0 percent of GDP. In the FY2022-2023 Budget, total expenditure is budgeted at 32.2 percent of GDP.

Operating Expenditure

3.12 Operating expenses escalated over the last several years and on average accounted for around 66.8 percent of the total government expenditure between FY2017-2018 and FY2021-2022. The largest component of operating expenditure is personnel cost or wages & salaries which accounts on average 41.8 percent of operating expenditures or 27.9 percent of total Government expenditure. Personnel costs rose on average by 8.8 percent between 2014 and FY2018-2019 before declining by 2.9 percent and 6.0 percent in FY2019-2020 and FY2020-2021, respectively. This decline was mainly attributed to nominal cuts in superannuation contributions and alignment of allowances, while overall civil servants pay was maintained during the pandemic. For FY2022-2023, personnel costs are expected to increase to $1,025.6 million to cater for increased superannuation contributions.

3.13 Between FY2017-2018 and FY2021-2022, transfer payments averaged 28.6 percent of total operating expenditures, followed by interest payments (14.7%) and supplies and consumables (11.5%), while the remaining 3.4 percent of operating expenditures comprised of purchase of outputs and other operating payments.

3.14 Spending on the social services sector accounts for a substantial portion of Government's total expenditure. Between FY2017-2018 and FY2021-2022, around 27.5 percent of the budget was spent on health, education and social protection programmes. In the same period, on average 8.0 percent was spent on economic services sector (dominated by the transport sector support and agricultural sector) and 14.2 percent to miscellaneous services (for unexpected events and crisis). The increased allocations in these areas were largely to help mitigate the effects of rising inflationary pressures on household incomes and includes post-pandemic financial support measures such as electricity and water subsidies, social welfare support, access to GPs and medical practitioners, support for transportation and waiver of certain fees and charges.

Capital Expenditure

3.15 Between FY2017-2018 to FY2021-2022, around 32.3 percent of Government's expenditure (10.6% of GDP) was channelled towards capital projects, which included the construction and maintenance of roads, bridges, water and sanitation facilities as well as the purchase of machinery & equipment. Although Fiji has a high degree of access to infrastructure, significant gaps and challenges remain especially in terms of implementing and managing capital projects. As such, prudently managing capital spending so that we can also reduce wastage and making public investment more resilient to climate change will ensure value for money and adequate return on investment.

Fiscal Balance

3.16 Fiscal deficits grew over the years. Fiscal deficit as a percent of GDP averaged -7.5 percent between FY2017-2018 and FY2021-2022. More precisely, double-digit deficits were incurred during the COVID-19 pandemic as significant declines were noted in revenues while Government maintained expenditures to around pre-COVID levels to deliver essential services and assist affected households. For instance, deficit rose sharply from -3.6 percent of GDP in FY2018-2019 to -11.4 percent in FY2020-2021 and -12.2 percent of GDP in FY2021-2022.

3.17 Given the rebound in economic activity driven by strong recovery in tourism and related sectors, Government budgeted for a smaller deficit of $872.2 million or 7.4 percent of GDP for FY2022-2023, with total revenue at $2,939.9 million and expenditure at $3,812.1 million.

Government Debt

3.18 Prior to the pandemic, the debt to GDP ratio remained below the generally accepted benchmark of 50 percent despite increased public spending on rehabilitation and reconstruction in the wake of TC Winston and other severe natural disasters experienced during that period. The debt trajectory was projected to improve in line with the fiscal consolidation plans in FY2018-2019, however was cut short by the onset of the COVID-19 pandemic.

3.19 Given the large deficits during the pandemic, Government's debt to GDP ratio increased from 48.8 percent pre-pandemic (FY2018-2019) to 91.1 percent of GDP ($9.1 billion) by the end of FY2021-2022 (**Table 2**). Debt is expected to further increase to around $10.0 billion by the end of July 2023, to around 84.6 percent of GDP.

Table 2: Government Debt

Particulars	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023 Budget
Debt ($m)	**5,220.5**	**5,735.3**	**6,686.0**	**7,663.7**	**9,131.5**	**10,003.7**
As % of GDP	45.8	48.8	62.5	83.6	91.1	84.6
Domestic Debt	**3,763.0**	**4,278.5**	**4,976.5**	**5,241.2**	**5,767.4**	**6,268.6**
As % of GDP	33.0	36.4	46.5	57.2	57.6	53.0
External Debt	**1,457.5**	**1,456.8**	**1,709.5**	**2,422.5**	**3,364.1**	**3,735.1**
As % of GDP	12.8	12.4	16.0	26.4	33.6	31.6

Contingent Liabilities

3.20 As at 31 December 2022, total contingent liabilities stood at $1.8 billion, equivalent to 14.8 percent of GDP. This comprises of:

3.20.1 Government guaranteed debt which stood at $1,125.2 million, equivalent to 9.5 percent of GDP for which existing guaranteed entities constitutes Fiji Airways ($476.1 million), Fiji Development Bank ($297.0 million), Fiji Sugar Corporation Limited ($268.6 million), Housing Authority ($81.7 million) and Pacific Fishing Company Pte. Limited ($1.1 million). Total guaranteed entities increased by 5.3 percent when compared to the outstanding balance as at 31 July 2022 and by 1.5 percent when compared to the same period last year. The increase was attributed to the utilization of approved guaranteed facilities by Fiji Airways, Fiji Sugar Corporation Limited and Pacific Fishing Company Pte Limited;

3.20.2 Total other explicit contingent liabilities stood at $554.4 million, equivalent to 4.7 percent of GDP comprising Government shares held with multilateral banks (IBRD, ADB and AIIB). This represents an increase by 0.5 percent when compared to 31 July 2022 and 3.8 percent increase when compared to the same period last fiscal year attributed to the appreciation of US exchange rate; and

3.20.3 Total other implicit contingent liabilities stood at $75.1 million, equivalent to 0.6 percent of GDP, representing a decline of 1.2 percent when compared to July 2022 and a sharp decrease of 16.1 percent when compared to the same period last fiscal year attributed to the timely servicing of provincial council's, municipal councils and FRCS's debt.

4.0 MEDIUM TERM FISCAL FRAMEWORK

Overall Fiscal Objectives

4.1 The Fijian economy is now on a double-digit recovery of 15.6 percent estimated for 2022 and a further 6.0 percent growth forecast for 2023. However, fully rebuilding the economy to pre-pandemic levels will take time as downside risks have intensified in the recent months. The anticipated slowdown in global growth and our major trading partners and tourism source countries may impede the pace of tourism recovery, while the on-going conflict between Russia and Ukraine will mostly likely keep commodity prices higher for a much longer period while natural disasters and other climate induced shocks and pandemic-related economic scarring could potentially weigh on growth in the near future.

4.2 Given the unprecedented increase in debt levels, the fiscal space has been exhausted. In fact, the room for any further increase in debt is almost non-existent. As such, Government needs to consolidate its fiscal position to rebuild fiscal buffers and reprioritize resources towards infrastructure development, expand social protection and improve overall services and at the same time ensure debt to GDP ratio is sustainable and on a downward trajectory in the medium term. In view of this, post-pandemic economic recovery must be driven by the private sector and policies and reforms should be targeted towards removing bottlenecks and bureaucracy and creating an enabling environment for investment.

4.3 While fiscal consolidation will have to be the cornerstone of fiscal strategy moving forward, the speed and timing of consolidation must be carefully managed with a delicate balance between ensuring fiscal sustainability and supporting economic recovery. Any premature withdrawal of fiscal support could potentially derail the recovery that is anticipated for the medium-term.

4.4 This medium-term fiscal framework (**'MTFF'**) focuses on making spending more efficient, streamlining taxes and working on revenue enhancing measures. Given that Government debt has increased sharply during the pandemic, any new expenditures financed through debt must ensure value for money, meets the broad development and investment objectives of the present Government, improves service delivery and continues to support post-pandemic economic recovery. This section presents the medium-term budget estimates with some policy actions that can be implemented to achieve broad fiscal targets.

Medium-term Revenue Forecasts

4.5 Based on the current tax policies and economic growth projections, the medium-term revenue forecasts are expected to normalize at around 22.5 percent of GDP, around 4 percentage points lower than pre-COVID levels. On the same note, given the need to continue with fiscal stimulus in the near term, it is imperative for Government to streamline and increase taxes, re-evaluate some of the tax exemptions and incentives and encourage self-regulation to improve tax compliance to fund for any additional expenditures.

4.6 The following will be the guiding policy principles in the medium term:

- Widen the tax base by gradually removing exemptions and other distortions;
- Improve tax compliance and collection of tax arrears;
- Make the tax regime and tax administration even simpler to encourage tax compliance; and
- Review non-tax revenues on a cost recovery basis while also ensuring that the vulnerable and disadvantaged are protected.

4.7 While the broad guiding policy principles entails medium to long term benefits of tax reforms, the immediate sustainability of fiscal targets rests critically on the Government's ability to immediately embark on the tax policy measures for macro-fiscal stabilization to put Government debt to GDP ratio on more sustainable and downward path. In this regard, Government will consider the following revenue policies in the upcoming budgets to increase revenues to pre-pandemic levels;

- Review the corporate tax rate and other tax incentives accorded to businesses;
- Review the departure tax in light of the removal of a whole list of tourism sector taxes like ECAL and STT;
- Review the excise tax on alcohol;
- Review the Export Income Deduction with a view to remove Fiji out of the EU blacklist;
- Review the VAT regime to move towards a single rate when the time is appropriate.

Medium-term Expenditure Forecasts

4.8 Government needs to cap expenditures or scale it back by reducing unproductive spending, reviewing/reducing transfers to extra budgetary units, streamlining operations and prioritizing high impact capital projects. In view of this, total expenditure in the medium-term should be reduced to below 30 percent of GDP with a capital operating mix of at least 30:70. Therefore, Government’s expenditure plans must be guided by these strategies;

- Undertake a holistic review to right-size the civil service and contain the public sector wage bill;
- Tighten control on operational expenditures, including travel, communications, trainings, workshops, fuel & maintenance and purchase of supplies with KPIs of agency heads and Permanent Secretaries linked to these targets;
- Conduct proper investment appraisal and project selection for all new capital projects;

- Resources must be allocated based on a multi-year perspective and the implementation capacity of agencies, considering the need to meet competing expenditure demands;
- Major existing programmes to be reviewed and Government should ensure that all financial resources allocated are used prudently to derive real value for money;
- All new initiatives to be rolled out in phases to manage costs and pilot testing should be done for the rollout of major initiatives;
- Encourage more private sector participation in public infrastructure projects and delivery of other public services through Public-Private Partnerships (PPP) and other innovative arrangements;
- Proper and effective monitoring of projects and budget utilisation through the Ministry of Finance; and
- Funding for ongoing programmes to be based on assessment of current and past performance and progressive achievement of planned outputs.

Medium-term Deficit Target & Financing Plans

4.9 The overarching goal of this medium-term fiscal strategy will be to reduce net deficits and put debt on a downward path to ensure fiscal sustainability. As such, increasing revenues to pre-pandemic levels and capping expenditures will be key. With some re-organization of expenditures and strengthening of tax revenue streams, Government can sustainably reduce net deficits in the medium-term.

4.10 In FY2023-2024, a net deficit target of $573.6 million or -4.5 percent of GDP will ensure continuity of public services without any major disruptions and can be easily financed domestically with some concessional external borrowing (**Table 3**). Consequently, Government debt will fall to 82.6 percent of GDP from 84.6 percent of GDP estimated for FY2022-2023.

Table 3: FY2023-2024 Fiscal Framework

($Million)	2022-2023 (Budget)	2023-2024 (Budget)	2024-2025 (Budget)	2025-2026 (Budget)
Revenue	2,939.9	3,246.1	3,383.0	3,466.2
As a % of GDP	24.9	25.3	25.0	24.3
Tax Revenue	2,322.1	2,789.9	2,934.6	3,034.4
Non-Tax Revenue	617.8	456.2	448.4	431.8
Expenditure	3,812.1	3,819.7	3,862.3	3,891.8
As a % of GDP	32.2	29.8	28.6	27.3
Net Deficit	**-872.2**	**-573.6**	**-479.4**	**-425.6**
As a % of GDP	**-7.4**	**-4.5**	**-3.5**	**-3.0**
Debt	10,003.7	10,577.3	11,056.6	11,482.2
As a % of GDP	**84.6**	**82.6**	**81.8**	**80.4**
GDP at Market Prices	11,827.3	12,811.8	13,524.2	14,276.1

4.11 In FY2024-2025 and FY2025-2026, net deficit targets of $479.4 million (-3.5% of GDP) and $425.6 million (-3.0% of GDP) can be easily financed domestically. Given these deficit targets, primary balance is projected to improve from -3.6

percent of GDP in FY2022-2023 to less than -0.1 percent by the end of FY2025-2026. Consequently, government debt as a percent of GDP will fall from 84.6 percent of GDP in FY2022-2023 to 80.4 percent by FY2025-2026.

Debt Management Strategy

4.12 The medium-term fiscal strategy will complement debt sustainability and fiscal discipline. The broad objectives of Government debt strategy in the medium-term will remain as follows:

- minimise the medium to the long-term cost of Government debt within prudent levels of risk; and
- support the development of a well-functioning domestic market for debt securities.

4.13 To achieve the above objectives, Government will focus on the following debt management policies to guide its borrowing in FY2023-2024 and onwards:

- lower the cost of debt through concessional financing from bilateral and multilateral lenders;
- change the maturity profile through a gradual reduction in Treasury Bills and issuances of short and medium-term bonds (2-year to 5-year tenor);
- continue issuances of long-term bonds (10-year to 20-year tenor) to finance deficits;
- develop the domestic bond market to focus more on transparency, secondary market trading, settlement mechanisms and investor diversification;
- consider callbacks, bond buybacks and switch operations; and
- minimise risks associated with on-lending and contingent liabilities.

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ment, and continuing momentum in tourist inflows could sustain above-trend economic growth in the near-term.

"Strong medium-term growth is vital to boosting living standards, reducing the public debt burden, and rebuilding resil-

tribute towards the economic rebound included promoting productivity growth, cutting the cost of doing business, enhancing social inclusion, and meeting the economy's investment needs against the backdrop of

manage future shocks. This will imply some medium term fiscal consolidation to bring down the debt to GDP ratio."

Mr Mills said that should be part of a comprehensive approach that included efforts to

help attract private and foreign investment.

Comprehensive tax reform strategy

By MONIKA SINGH

THE International Monetary Fund (IMF) mission to Fiji says as external sector conditions improve there is room for the reversal of the additional exchange restrictions on current transactions and capital flows measures that were implemented in April 2020.

Led by Marshall Mills, the team said Fiji was experiencing a strong economic recovery from the pandemic with its real GDP growth rebounded by an estimated 16.0 per cent in 2022 driven by the strong revival in tourist inflows.

Mr Mills said supported by the strong economic recovery, fiscal deficits were falling from 12.2 per cent of GDP in FY2022 to a projected 7.7 per cent for FY2023.

"In this context, the team strongly welcomes the authorities' commitment to ensure fiscal sustainability, reflected in the medium-term fiscal strategy and the recent appointment of the 2023 Fiscal Review Committee."

He said the IMF team recommended to front-load the fiscal consolidation with a comprehensive tax reform strategy in the forthcoming budget which raises revenue, simplifies the tax system, and enhances efficiency.

"Suggested measures include unifying the VAT rate at a slightly higher level; simplifying personal and corporate income taxes, especially by reducing tax exemptions; and raising certain excise and tourism-specific taxes. While tax reforms are necessary to raise revenue, they should be accompanied by targeted transfers to low-income households and growth-enhancing measures."

The team recommended that monetary policy should start now to gradually unwind the accommodative stance, which was an appropriate response to the pandemic.

Other recommendations by the team include moving to a more neutral stance by addressing the historically high levels of liquidity and low interest rates would put the RBF in a position to manage pressures on inflation or reserves as they emerge.

The team highlighted the need to pay close attention to monitor non-performing loans that remained significantly above pre-pandemic levels. The team urged continued progress on anti-money laundering and international tax issues and suggested examining how to phase out other long-standing exchange restrictions that add to business costs and deter investment.

Current Fiji Interest Rates

Term Deposits	1 year	3 years	5 years
ANZ	0.30%	0.30%	0.30%
BoB	0.60%	0.60%	0.60%
BSP	0.30%	0.30%	0.30%
Bred	0.50%	1.00%	1.00%
BSP Finance	2.50%	-	-
Credit Corp	1.25%	1.75%	2.25%
HFC	1.00%	1.00%	1.00%
Kontiki Finance	1.75%	2.25%	3.00%
Merchant Finance	1.50%	2.50%	2.70%
WBC	0.25%	0.40%	0.50%
FDB	1.00%	1.75%	2.25%

Home Loans	Variable	1 year Fixed	2 year Fixed
ANZ	6.49%	4.15%	4.95%
BoB	4.99%	3.75%	3.95%
BSP	6.50%	4.95%	5.45%
Bred	6.25%	4.00%	4.95%
HFC - SDHL	6.35%	3.99%	4.50%
WBC	6.49%	4.75%	5.45%

Focus 1:

The Circular Economy, Background, Government Policies and Business Models

2023 Fiscal Review Committee:

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Policy for material efficiency—sustainable taxation as a departure from the throwaway society

Walter R. Stahel

7 chemin des Vignettes, Conches 1231, Switzerland

Research

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Subject Areas:
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Author for correspondence:
Walter R. Stahel
e-mail: walter_stahel@genevaassociation.org

The present economy is not sustainable with regard to its *per capita* material consumption. A dematerialization of the economy of industrialized countries can be achieved by a change in course, from an industrial economy built on throughput to a circular economy built on stock optimization, decoupling wealth and welfare from resource consumption while creating more work. The business models of a circular economy have been known since the mid-1970s and are now applied in a number of industrial sectors. This paper argues that a simple and convincing lever could accelerate the shift to a circular economy, and that this lever is the shift to a tax system based on the principles of sustainability: not taxing renewable resources including human labour—work—but taxing non-renewable resources instead is a powerful lever. Taxing materials and energies will promote low-carbon and low-resource solutions and a move towards a 'circular' regional economy as opposed to the 'linear' global economy requiring fuel-based transport for goods throughput. In addition to substantial improvements in material and energy efficiency, regional job creation and national greenhouse gas emission reductions, such a change will foster all activities based on 'caring', such as maintaining cultural heritage and natural wealth, health services, knowledge and know-how.

1. Introduction

Previous patterns of growth have brought increased prosperity, but through intensive and often inefficient use of resources. The role of biodiversity, ecosystems and their services is largely undervalued, the costs of waste are often not reflected in prices, current

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> markets and public policies cannot fully deal with competing demands on strategic resources such as minerals, land, water and biomass. This calls for a coherent and integrated response over a wide range of policies in order to deal with expected resource constraints and to sustain our prosperity in the long run. [1]

This statement by the European Commission analyses today's resource efficiency and policy shortcomings. But it does not show roads to solutions, it does not address work as a resource and it leaves out a number of challenges which most industrialized countries are confronted with at the beginning of the third millennium, such as how to

— integrate sufficiency strategies and renewable energies to mitigate climate change,
— identify new business opportunities in the saturated markets for many durable consumer goods in Europe,
— balance rapidly ageing populations, the potential of 'silver workers' and the influence on pensions, and
— tackle the sovereign debt problem in light of the need to renew ageing infrastructure in a time of austerity.

Economic actors in the circular economy have started to tackle many of these issues in a bottom-up approach by introducing new private sector business models of the circular economy, such as 're-use, repair and remanufacture instead of replace', and 'selling goods as services'.

A shift to a sustainable taxation constitutes a giant booster to multiply the benefits of a circular economy within a national economy. Other taxation and public procurement policies that would further benefit national economies and enhance the circular economy will be detailed later. The emphasis of this paper is on the efficient use of labour as a renewable resource with a qualitative edge, and 'an economy as if people mattered' [2].

The multiple advantages of a circular economy have been described decades ago by Stahel & Reday [3,4], and have started to transcend into policymaking, as for instance in the 2008 European Union (EU) Waste Directive. However, politicians' reflexes are still geared to overcome economic problems by promoting growth in the industrial production economy—witness the 'cash for clunkers' initiatives in 22 countries in 2010—or by focusing on singular issues, such as environmental solutions. The quest for sustainable (holistic) solutions, which would simultaneously address economic, social and environmental issues, is jeopardized by the 'silo' structures of public administrations, academia and many corporations. Stahel [5,6] showed that most sustainable solutions are intersectoral and interdisciplinary and thus contradict existing regulations, do not fit into academic career structures and demand a 'new think'.

This paper shows the characteristics of, and advantages inherent in, the circular economy and argues that the shift to a circular economy can be accelerated by one simple shift in public policy—adapting the tax system to the principles of sustainability by not taxing renewable resources including work. This will bring about a rapid expansion not only of the circular economy for manufactured capital (infrastructure, equipment and goods) but equally of all other economic activities based on stock optimization and 'caring', such as health services, education, organic agriculture, and producing goods from such locally available renewable materials as leather, wood and wool. Caring is also the foundation for maintaining our cultural heritage (§6).

The author's previous paper for the Royal Society 'The service economy: "wealth without resource consumption"?' had proposed such a change 15 years ago but underestimated the inertia of public policymaking, as the abstract of the 1997 paper shows:

> The present economy is not sustainable with regard to its per capita material consumption in the industrialised countries. A dematerialisation of the economy of industrialised countries can only be achieved by a change in course, from an industrial economy where success is measured in throughput and its exchange value, to a service economy where success is measured in wealth (stock) and its usage value. Wealth management, new corporate and industrial design strategies and different economic policies can lead to a higher sustainability as well as an increased international competitiveness due to substantially higher resource productivity. [7]

A higher sustainability will not only result from a change in public policy, but the principles of sustainability can be the driver to defining the framework conditions of a future public policy (see also [8]).

The term 'material efficiency' was coined by Allwood *et al.* [9]. The concept of a circular economy has many similarities with related concepts, such as closed loop economy, lake and loop economy, industrial ecology, cradle to cradle, and material efficiency.

2. A circular economy is about economics and profit maximization

This section details the circular economy, its focus on stock optimization and its structure of two loops of different nature and five principles. It explains why reuse and service-life extension of goods are the most profitable and resource-efficient business models of the circular economy. From an economics view, maintaining value and performance of stock replaces value added of flow, and utilization value replaces exchange value as a central notion of economic value.

Before 2012, few studies existed which analysed the economic benefits of a circular economy on a national or supranational level. In time for the World Economic Forum 2012 in Davos, the London-based Ellen MacArthur Foundation [10] published a report which calculates that a circular economy (better design and more efficient use of material) could save European manufacturers US$630 billion a year by 2025. The report produced by consultancy McKinsey only covers five sectors that represent a little less than half of the gross domestic product (GDP) contribution of EU manufacturing, but still calculates that greater resource efficiency could deliver multi-billion euro savings equivalent to 23 per cent of current spending on manufacturing inputs.

The following abstract of 'the product-life factor' [11] for the topic on 'the role of the private sector in a sustainable society' [12] is still an excellent summary of the circular economy:

> This paper attempts to show that the extension of the use-life of goods is, first, a sensible point at which to start a gradual transition towards a sustainable society in which progress is made consistent with the world's finite resource base and, second, a strategy consistent with an active and independent role for the private sector. Product-life, or the period over which products and goods are used, governs their replacement speed and thus the consumption of natural resources required for their manufacture and the amount of waste they create. Shortening product-life increases demand for replacement goods where these can be afforded. Extending product-life optimizes the total life-span of goods and reduces depletion of natural resources and consequently waste; it builds on and increases wealth. Longer use of products will thus contribute to the transition towards a sustainable society. Compared to fast-replacement, product-life extension is a substitution of service activities for extractive and manufacturing industries, and a replacement of large-scale capital-intensive companies by smaller, labour-intensive, locally integrated work units. The private sector, whether R&D, manufacturing or finance, will find innumerable business opportunities in product-life extension activities—Reuse, Repair, Reconditioning and Recycling. Indeed, while increasing the number of skilled jobs available and reducing our dependence on strategic materials, such activities will provide the private sector with fresh impetus to make cheaper goods available as part of a self-replenishing economy built on a spiral-loop pattern which allows a substitution of manpower for energy. In this way, unemployment and poverty which certainly aggravate the fundamental instability of the world economy might be substantially reduced. The private sector has, moreover, resources and skills that uniquely qualify it to initiate this transition towards a sustainable society where a balanced use of resources and other societal goals are achieved. Potential disincentives and obstacles can, we believe, be overcome with appropriate education and fiscal and policy measures. [11]

A circular economy is about stock optimization. New metrics to measure changes in the quantity and quality of stock—wealth in the form of manufactured capital stock, but also of health, education and skills—are needed to manage stock. We know how much money governments spend on building schools and employing teachers, but we do not know if as a result the students are better prepared for life. The stock of buildings in a given country and their qualitative

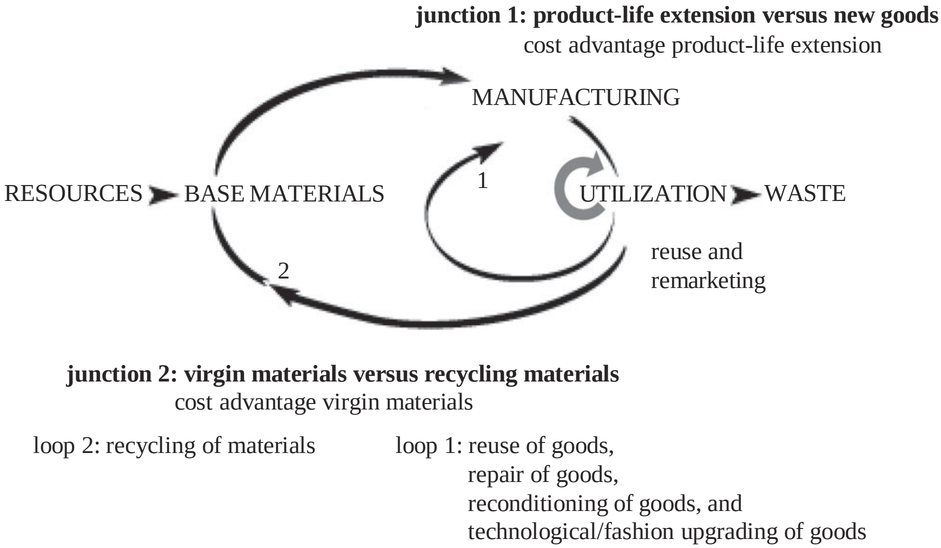

Figure 1. The main loops of a circular economy (adapted from Stahel & Reday-Mulvey [4]).

conditions (thermal insulation, annual energy consumption) are not known, nor the residual service-life of infrastructure or technical equipment—which makes a national stock and thus wealth management difficult.

(a) The economic logic of loops

Turning the linear industrial economy into a loop or circular economy is, by definition, reducing the economic importance of resource extraction and waste management, and also reducing the environmental impairment caused by these industrial sectors. This change of focus from a linear throughput to a stock management opens opportunities in three loops of different characteristics, which are described in this section and shown graphically in figure 1: (i) a reuse and remarketing loop for goods, (ii) a loop of product-life extension activities of goods, and (iii) a recycling loop for molecules (secondary resources).

A circular economy is characterized by a number of principles which do not exist in the linear industrial economy. Policymakers and economic actors of the manufacturing economy therefore do not know them, nor their impact on the economy.

(i) Principle 1: the smaller the loop (activity-wise and geographically) the more profitable and resource efficient it is

Activity-wise, this means 'don't repair what is not broken, don't remanufacture what can be repaired, don't recycle what can be remanufactured' (loop 1), and geographically 'the small loops (reuse, repair and remanufacture) are best done locally or regionally', avoiding packaging and transport costs, and, if ownership is maintained, avoiding multiple transaction costs.

Recycling—the large loop 2—is by contrast a global business based on the principles of industrial production, such as economies of scale, specialization and employing the cheapest labour, and an activity whose efficiency is restrained by entropy (the second law of thermodynamics), material complexity (alloys, leading to down-cycling) and abuse. For instance, sending used electronic goods to Africa for remarketing but ending up in cheapest and most polluting 'incineration-recycling'. The Basel Agreement allows exports of used goods for remarketing, but forbids exports of wastes.

(ii) Principle 2: loops have no beginning and no end

The concept of maintaining value, quality and performance of goods through stock management replaces the concept of value added in the linear economy; the values preserved include the materials, water and greenhouse gas (GHG) emissions embedded in the goods.

Utilization, usage or replacement value replaces the concept of residual or depreciation value in the linear economy. The loops remain transparent; new economic actors can enter at any transaction point.

(iii) Principle 3: the speed of the circular flows is crucial: the efficiency of managing stock in the circular economy increases with a decreasing flow speed

Material recycling of such short-lived goods as beverage cans leads to fast circular flows and a rapid loss of the material stock (the 'reversed resource compound interests'): 50 per cent recycling means 50 per cent of the original material is recycled in the first cycle, 25 per cent in the second cycle, 12.5 per cent in the third etc. This means the total loss of the original material in a short time.

Reusable glass bottles used for mineral water in Switzerland, by contrast, are refilled 27 times, corresponding to a product-life of one and a half years, before being recycled. This success may partly be due to the fact that the bottles are used within a deposit scheme.

The most profitable and resource-efficient business models of a circular economy—the lake economy of fleet management and selling goods as services—operate with a slow flow speed in a regional economy to maximize profits.

A speed differential of a different kind exists between remanufacturing in the circular economy and manufacturing in the industrial economy: all but two of the battleships sunk at Pearl Harbor were remanufactured and recommissioned within one year and contributed to win the war in the Pacific. The shipyard and steelmaking capacity to build new ships to replace the losses was simply not there, and would have taken much longer.

(iv) Principle 4: continued ownership is cost-efficient: reuse, repair and remanufacture without a change of ownership save double transaction costs

Retreading and regrooving used truck tyres is the norm. Tyre ownership remains with the fleet manager and retreading is done by a third-party contractor as a service. In the case of tyres sold as a service (tyre manufacturers selling tyre usage), tyre manufacturers have developed mobile workshops to provide an optimal on-site service to the tyre users. Extending the service-life of tyres at the lowest cost, according to the principles of the circular economy, or in this case the performance economy, increases the tyre manufacturer's profits.

The case is different for used car tyres in industrialized countries, which are collected by waste dealers, and possibly sold to retreaders, which after extensive quality control and retreading sell them to individuals. However, most used car tyres are not retreaded or recycled as materials but incinerated in cement kilns. There are two reasons for this product-life abortion: state subsidies for incineration and the mistrust for retreaded car tyres by buyers doubting their quality 'as good as new'. The fact that the tyres are a third cheaper than new ones of similar quality—despite the transaction costs—is reinforcing this belief, rather than taken as proof of a more sustainable solution.

(v) Principle 5: a circular economy needs functioning markets

In this aspect, the circular economy does not differ from the industrial economy; it needs efficient market places where supply and demand can meet. This concerns services for the service-life extension of goods, such as component repairs, remanufacturing and technological upgrading, as well as to remarket used goods and components.

Functioning markets are also needed to achieve the lowest cost. In the linear economy, goods are depreciated and, for instance, in the case of a liability insurance claim, reimbursed at the residual value; insurers have no interest in a functioning second-hand car market and a customer who has shown a caring attitude will feel punished. In the circular economy, where quality of stock, not age, determines value, the insurer will have to replace the damaged good, for instance, a car, with a vehicle of similar quality and age, or pay the customer the replacement value. Insurers now have an interest in a second-hand market with a wide offer of cars of all ages and qualitative condition to minimize their payments for losses.

Service-life extension services to repair manufactured capital—vehicles, equipment, aircraft, ships, buildings and infrastructure—exist locally worldwide. Remanufacturing services for one-off jobs are also offered locally in urban areas; remanufacturing on an industrial scale, however, is done regionally to achieve a certain economy of scale—witness Caterpillar's remanufacturing factories for diesel engines in the USA, UK and China.

Reuse and remarketing services for *used mobile investment goods*—vehicles, equipment, aircraft and ships—and buildings exist in most countries, and these goods have been traded on international markets for a long time. Cultural goods, such as paintings, antique furniture and artworks, have traditionally been repaired periodically and traded at auction houses.

Market places for *used consumer goods* have typically flourished through advertisements in local newspapers and at stationeries, as well as in flea markets. Their international remarketing, however, has only taken off with the emergence of electronic market places, such as eBay.

The remarketing of used goods and components by fleet managers is only picking up when they realize their key role in remarketing goods which they no longer need. Lufthansa is a pioneer in this respect, devoting half a page of its in-flight magazine (see the World-Time page) to advertise the fact that it sells used aircraft seats (during a D check, all seats and other fittings are changed for safety reasons). Instead of paying a recycler to destroy these seats, Lufthansa now receives money for the reuse of these seats in, for instance, theatres and cinemas—an example of the 'new think' necessary to fully exploit the opportunities of the circular economy.

(b) Impacts of sustainable taxation on the economy

Not taxing renewable resources including work and taxing non-renewable ones instead (i) speeds up the economic transformation from flow to stock optimization, (ii) broadens the application of the circular economy to new economic actors and new sectors, and (iii) increases the competitive advantage of existing economic actors of the circular economy.

The relevance of a circular economy to solving today's problems is its high-labour but low-carbon and low-resource nature, its reliance on small and medium-sized enterprises and regional activities, and its objective of preserving existing manufactured capital with its embedded resources (value preserved).

At junction 1, used goods in the loop economy today already have a cost advantage of about one-third compared with new goods. Sustainable taxation will increase this comparative advantage in two ways, through lower labour costs in service-life extension activities and higher virgin material costs in competing manufactured goods.

At junction 2, taxing non-renewable virgin resources will make recycling—the reuse of molecules—more profitable for those materials where virgin resources today have a cost advantage. Furthermore, not taxing work will make the collection of end-of-life wastes (secondary resources) and sorting them into pure mono-materials cheaper, thus increasing the quality of secondary resources (by reducing down-cycling) and consequently the market prices for secondary (recycled) resources.

(c) Impacts of the circular economy on material efficiency

The key characteristics of a circular economy are its focus on stock optimization through value preservation and waste prevention [13], which enables it to provide 'material services' by extending the service-life of existing materials embedded in manufactured capital. The ultimate exploitation of existing materials is the business model of selling goods as services and maintaining resource ownership over the full product-life. It is detailed in §7.

3. A circular economy is about material and resource sufficiency and efficiency

This section presents new metrics to measure material efficiency, and quantifies the reductions in material consumption and emissions that can be achieved in the circular economy.

Stahel [14] showed that many different types of innovation to increase material efficiency exist in the circular economy, including technical, commercial and 'utilization' innovation. A longer utilization—long-life products, reuse and service-life extension of goods and components, as explained in this paper—is one option. A more intensive use of goods is another utilization innovation to achieve a higher material efficiency, for instance, through shared utilization (together, public transport) or serial utilization of goods (one after another, washing machines in self-service laundries and rental cars). These options need a 'new relationship with goods' and were extensively discussed in the early 1990s [15] but are only now finding a real interest on both the supply and demand side, for example, in car-sharing initiatives.

New metrics are needed to measure material efficiency in relation to other factors. Stahel & Zlotopolsky [16] developed the energy capital per unit of performance (ECUP) ratio to judge the engineering performance of different building materials (in kp cm^{-2}) related to the energy invested in their production (in kWh m^{-3}). ECUP represents the energy capital necessary to withstand one tonne of tension or compression. Allwood *et al.* [9] have developed a number of metrics including an embodied energy per cubic metre ratio. But more comparative metrics will be needed to help engineers include energy and material efficiency in their decisions.

Two distinctively different types of resource efficiency govern the circular economy: loop 1 in figure 1 is about resource sufficiency in the reuse and service-life extension of manufactured capital, loop 2 is about material efficiency in recycling materials (molecules).

The strategies of loop 1 are product specific—re-refining engine oil, solvents and other products with a catalytic function needs a different approach from the service-life extension activities for buildings or mobile durable goods. The latter's resource efficiency can be improved by modular system design, component standardization and other eco-design (design for environment) approaches which are now well known and documented, for instance, by Charter & Tischner [17]. Some examples for the savings in resource consumption and reductions of environmental impairment achievable in extending the service-life of durable goods are given in §3*a*,*b*.

The strategies of loop 2 are material-specific—metals, ceramic materials and plastic use processes of physical and chemical recycling often derived from manufacturing processes, as well as new processes such as the depolymerization of polymers. Materials with a low price/weight ratio, such as brick and concrete waste from demolishing buildings, are best crushed, using mobile equipment, for reuse as recycling concrete on-site for new constructions.

All materials come with a multiple backpack (*rucksack*) of mining waste [18] and environmental impairment. These backpacks differ for each material and are highest for rare metals such as gold (with a backpack of 500 000), lowest for plastics (with a backpack of 0.1). Manufactured capital in the form of infrastructure, buildings, goods and components has individual accumulated backpacks of all the materials and energies they embed, which have to be calculated individually.

Manufactured capital contains, in addition to the backpacks of the materials it is made of, the sum of the embedded energy and GHG emissions as well as the embedded (virtual) water of the manufacturing steps from basic materials into finished goods and up to the point of sale.

The reuse, remarketing and service-life extension activities in a circular economy preserve the mining backpacks of water and energy inputs and related GHG emissions in the manufacturing chain up to the point of sale, which are embedded in the finished goods. In addition, they also prevent the environmental impairment of the material recycling and/or waste management processes. The exact percentages of preserved materials and emissions are substantial and vary between types of goods; two microeconomic examples can give an idea of the orders of magnitude achievable.

While loop 1 (reuse, repair and remanufacturing) preserves the mining backpacks of the basic material and the embedded energy and virtual water of the manufacturing phase of goods, loop 2 (material recycling) mainly preserves the backpacks of the basic materials. In a few cases, such as aluminium, recycling also maintains a major part of the embedded energy.

(a) The redesign of the German high-speed (ICE 1) trains [19]

The 59 ICE1 high-speed trains of the German Railways clocked up 15 million km each in the first 15 years of operation. The railways then decided to remanufacture and technologically upgrade the trains to bring them to state-of-the-art quality.

The cost of the redesign was €3 million per train, compared with procurement costs of €25 million for a new train. In addition, the redesign saved social costs of €1 million on a global level, taking into account the analysis of the Stern report.

The redesign conserved 80 per cent of materials and embedded water and energy—a total of 16 500 tonnes of steel and 1180 tonnes of copper—and prevented 35 000 tonnes of CO_2 emissions and 500 000 tonnes of mining waste backpacks. The redesign included a technologic upgrading of the trains and an increase in the number of seats. Each seat now offers individual power outlets and Internet connection.

This analysis did not take into account the sufficiency aspects of service-life extension, such as the prevention of environmental impairment in the phases of waste management and material recycling, which would have been realized if the trains had been replaced by new ones, nor the water consumption of these processes.

(b) Macroeconomic studies on the material efficiency of the circular economy

A sectorial study on industrial ecology savings by Smith & Keoleian [20] on restoring used automotive engines to a like-new condition showed lower economic costs (30–53%) and much lower environmental costs, compared with manufacturing engines.

Raw material consumption was down by 26–90%, waste generation by 65–88%, energy consumption by 68–83%. Emissions were also considerably lower: carbon dioxide (CO_2) emissions by 73–78%, CO by 48–88%, NO_x by 72–85%, SO_x by 71–84%, non-methane hydrocarbons emissions by 50–61%.

Another macroeconomic approach, based on the UK input–output model to calculate the prevention of CO_2 and GHG emissions in a circular economy, was used in a study for the UK Waste Reduction Action Plan [21]. It concluded that a circular economy could reduce UK national GHG emissions by 800 million tonnes annually. By comparison, the German law for energy feed-in tariffs to promote solar electricity has achieved an annual reduction of 100 million CO_2 emissions.

(c) Impacts of sustainable taxation on material and resource sufficiency and efficiency

Taxing the consumption of non-renewable resources provides financial incentives for economic actors to minimize resource consumption, losses and waste. Water and energy savings as well as waste prevention become profitable activities that impact the financial bottom line of corporations and to a rising degree if resource prices continually rise.

At junction 1, not taxing work as a renewable resource favours the reuse, repair and remanufacturing activities of the circular economy, which remanufactures worn components instead of producing new ones from virgin materials. This achieves a substantially higher material efficiency than manufacturing new components from virgin or even secondary resources.

In addition, the regional nature of the circular economy, in comparison to global manufacturing chains, substantially reduces the transport energy involved.

At junction 2, many used materials today have a higher price than virgin materials, because of a ‘Catch-22’ situation: the recycling of high-quality high-price material needs labour-intensive sorting into clean mono-materials, in order to achieve the highest prices in the secondary resource markets. Alternatively, mass recycling can be done using machines but leads to down-cycling (lowest grade material) and mixed secondary resources, which fetch a low market price [22].

A sustainable taxation therefore promotes high-quality labour-intensive approaches by lowering the labour cost in sorting used material, and simultaneously raises the price of non-renewable virgin materials at junction 2 of the circular economy.

(d) Impacts of sustainable taxation on non-renewable material consumption

Taxing non-renewable resources should create virtuous loops of using materials more efficiently to save money, and thus reduce consumption. A recent study has shown that taxes on natural resources do reduce the use of raw materials. The study investigated how taxes on virgin raw materials used in construction, such as gravel and sand, have reduced the use of these resources, based on experiences in Denmark, Sweden and the UK. However, the study also suggests that greater incentives to recycle these materials are still needed [23].

4. A circular economy is about an intelligent use of human labour—job creation in a regional economy

This section explains why human labour—work—is different from the other renewable resources: creative, versatile and adaptable, able to be educated but perishable if unused. The circular economy needs workers familiar with past technologies and thus offers jobs for 'silver workers'.

> Roughly three quarters of all industrial energy consumption is associated with the extraction or production of basic materials like steel and cement, while only about one quarter is used in the transformation of raw material into finished goods such as machines and buildings. The converse is true of labour, about three times as much being used in the conversion of materials to finished products as is required in the production of material.
>
> [11]

(a) The labour intensity of the circular economy

The reuse, repair and remanufacturing activities of the circular economy resemble the phase of the manufacturing economy which transforms basic materials into finished goods. Before robots replaced human labour in production, this phase was low-energy but labour-intensive.

But even compared with the traditional manufacturing process, the labour input of the circular economy is higher as (i) its economies of scale are limited in geographical and volume terms and (ii) remanufacturing comprises additional steps of dismantling, cleaning and quality control, which are absent in manufacturing.

No estimations exist on the impact of a circular economy on a national labour market. The 2012 report produced by McKinsey for the London-based Ellen MacArthur Foundation [10] did not to give such estimations because the economic models available to McKinsey do not allow such a calculation.

Few case studies on the substitution of manpower for energy through a long-term utilization of goods have been done, except for a number of vehicles up to 30 years by the Geneva-based Product-Life Institute [24]. Academic research has focused on prospective life cycle analysis, but not on real cases, probably because of the time lag involved (who wants to do a PhD over a period of 30 years?).

(b) Human labour as a resource

Employment is at the heart of the social pillar of sustainability. Furthermore, substituting labour for other resources is also an intelligent solution for reasons which are inherent in human labour—it is the only renewable resource with a qualitative characteristic. Work is the most versatile and adaptable of all resources, with a strong but perishable qualitative edge: (i) it is the only resource capable of creativity and with the capacity to produce innovative solutions and (ii) human skills deteriorate if unused—continuity of work and continued learning are necessary to maintain skills and upgrade capabilities. A person who has been unemployed for a few years risks becoming unemployable.

People at work are a desire for nation states. Governments invest on average 10 years in education and vocational training to teach young people marketable skills, and unemployment—wasted human resources—represents a high cost to governments and a lost opportunity for the national economy. In addition, labour is a zero-carbon energy; human CO_2 emissions are the same for working and unemployed people.

Furthermore, governments should give priority to human labour in resource use because a barrel of oil or a ton of coal left in the ground for another decade will not deteriorate, nor will it demand social welfare, and not taxing labour reduces incentives for black labour in the shadow economy and thus reduces the costs for governments to monitor and punish abuses.

Schumacher [2] went even further in chapter 1 of his book: ‘All history—as well as current experience—point to the fact that it is man, not nature, who provides the primary resource: that the key factor of all economic development comes out of the mind of man’. Schumacher goes on saying that progress comes through education: ‘in a very real sense, therefore, we can say that education is the most vital of all resources’.

(c) Impacts of sustainable taxation on employment

Not taxing labour as a renewable resource creates virtuous loops, which boost job creation, employment and occupation in all forms and in all labour-intensive economic sectors, including those involving caring or using local renewable resources, such as biological and organic agriculture, food from oceans, regional production of wooden furniture, wool textiles and leather shoes and goods.

As the knowledge and know-how of past technologies are necessary for retrofitting infrastructure and equipment, extending the service-life of equipment creates meaningful employment opportunities for ‘silver workers’, people beyond the traditional age of retirement. Continued (part-time) employment then provides a ‘fourth pillar’ of revenue to complement income from pension schemes and savings, whose future is uncertain (‘The Four Pillars’ is a research programme running since 1986 of the Geneva Association, http://www.genevaassociation.org/Research_Programme/Four_Pillars_Pensions.aspx).

(d) Impacts of job creation in a regional economy on material efficiency

Technological progress changes skills as much as goods. Maintaining manufactured capital also means maintaining the crafts and know-how that go with it: the upkeep of mediaeval cathedrals is only possible by masons capable of working dimension stone; driving old-timer cars also relies on mechanics capable of tuning a Solex carburettor; operating and maintaining electromechanical control rooms of hydroelectric power stations needs experts with the knowledge of electromechanical equipment.

The combination of maintaining technical skills and know-how and manufactured capital will enable a longer term exploitation of the opportunities of the circular economy, with a corresponding increase in material efficiency.

5. A circular economy is about caring

This section shows why the circular economy needs and creates a caring attitude to preserve the quality and value of existing stock; metrics are necessary to measure variations in wealth, which is a variation in the quantity and quality of stock.

One of the objectives of a circular economy is to preserve the quality, performance and value of the existing stock, wealth and welfare. This certainly concerns manufactured capital, such as buildings, infrastructure, equipment and goods.

Stock management needs statistics and metrics to measure the variations of wealth owing to variations in the quality of stock. GDP is a flow metric, ignoring if our wealth—the stock—has increased as a result of the flow. This situation has been compared with a bath tub where only the inflow of hot and cold water is measured, but the outflow and the water level are ignored [25].

And stock management includes people's skills, education and health, knowledge and know-how. Preserving culture is also linked to stock, not flow management; maintaining the UNESCO world heritage sites, museums and examples of technological achievements will all profit from the shift in taxation towards the non-taxation of renewable resources. And caring is a high-quality world: Stradivari instruments and expensive watches do not live forever by design, but through periodic remanufacturing, motivated by caring.

Caring is a key characteristic of managing stock—caring for keeping up existing values and qualities. Most car owners will credit the manufacturer of their vehicle for its continued reliable functioning, rather than their mechanic who provides the maintenance and repair services. A change in popular values and beliefs would multiply the perception of caring as a pillar of the (circular) economy. The fleet of vintage and old-timer cars in the UK could be a point in case.

(a) Impacts of sustainable taxation on caring

Sustainable taxation will reduce the costs of activities involving 'caring' and also help in understanding the link between caring and our relationship with goods, which in turn might increase the number of activities involving human creativity in the circular economy.

(b) Impacts of caring on material efficiency

Stock optimization depends on high-quality operation and maintenance services, which are influenced by caring, visible in a husbandry and careful use of manufactured capital. This in turn increases material efficiency by reducing, for instance, material wastage (repair instead of replace).

6. Retained ownership of goods and embedded material provides future resource security

This section looks at why selling goods as service, or performance, is the most profitable and resource-efficient business model of the circular economy. By focusing on systems solutions, it internalizes the cost of risk and of waste; by retaining the ownership of goods and the embedded resources, it creates a corporate and national resource security for the future.

Many economists have a problem accepting that this is a discontinuity in traditional economic business models, and look at the sale of performance as an extension of the aftermarket [26].

Economic actors retaining material ownership over the full life of their products gain a future resource security but accept a liability for the performance of their goods. Such a performance economy [27] is based on the triple objectives of more growth and more jobs in combination with substantially reduced resource consumption. This triple objective can be achieved through three new business models: producing performance, selling performance and maintaining performance over time.

Success is measured using two new metrics in the form of absolute decoupling indicators: value per weight (UK£ kg^{-1}) and labour-input per weight (man-hours kg^{-1}).

In the performance economy, providing materials services can be achieved, for instance, by building residential housing without capital. The developer rents all material and equipment from the manufacturers, say over a period of 50 years, who in return receive a yearly rent, financed by the rental income from the apartments. As the manufacturers have to give a 50 year guarantee for their material, they will make sure that the most appropriate material is used and applied correctly (renewable urban space initiative, see [27, p. 156]).

(a) Retaining ownership of goods and embedded resources by selling performance

Selling performance differs according to the characteristics of products and is widely present in today's economy: selling goods as services by operating private and public networks (railways, telecoms, motorways, airports); chemical management services and rent-a-molecule; energy management and integrated crop management services; rental and operational leasing of real estate; selling custom-made indoor climate for energy companies; private finance initiatives as a strategy to sell the utilization of infrastructure according to the 'consumer pays principle', such as the French and Italian toll motorways; facility management of real estate and industrial plants; textile leasing (professional attire, hotel and hospital linen). These are but a few examples of the business model of selling performance.

In the 1990s, Stahel [28] called the concept of selling performance 'the functional service economy'. This term is still used in French (*l'économie de fonctionnalité*) as a translation of the performance economy. The term was chosen because selling goods as services in the beginning focused on the function of investment goods, in contrast to fashion for selling consumer goods, also referred to as tools and toys. Today, the business model also includes renting fashionable consumer goods, taking the waste out of fashion (e.g. websites to rent ladies' handbags).

Selling performance is the most profitable and most material-efficient business model of the circular economy, as it is built on exploiting the small loops. It focuses on utilization optimization and exploits resource efficiency as well as sufficiency and prevention options to gain financial advantages and higher competitiveness. Water and energy savings as well as waste prevention now become profitable activities that positively impact the financial bottom line of corporations. Whereas in the industrial economy, sufficiency and prevention options during the utilization phase of goods present a loss of income, and are thus undesirable.

For the same reason, the focus of industrial design shifts from products to designing systems solutions in order to achieve more profitable sustainable solutions. Xerox's business model of selling customer satisfaction instead of copiers was a precursor of this strategy and was chosen by the Harvard Business School [29] as the first case study on the functional service economy; the case study was titled 'Xerox: design for the environment'. Xerox is an excellent example that a leap in resource efficiency can be achieved by shifting from 'design for environment' to 'designing sustainable solutions', a strategy promoted by Stahel [5,6].

(b) Selling the performance of goods implies internalizing the costs of risk and of waste

Selling performance, results, utilization, services instead of goods means that economic actors

(i) internalize the cost of risk and of waste and
(ii) retain the ownership of goods and embedded resources.

By comparison, the industrial economy maximizes its profit by externalizing the cost of risk and of waste. After the point of sale, it offers a warranty for a limited period of time and limited to manufacturing defects. A liability for goods beyond the point of sale was only imposed recently, in the cases of the tobacco industry (liability for health impairments from cigarette smoke) and the asbestos industry (under an extended liability for workers' health and safety). Since the beginning of the third millennium, there has been a generalization of liability claims, such as class action suits. According to Richard Murray,[1] an expert in this field, society is confronted with a situation of accelerating 'liability dynamics'. The next case could well be a liability of local CO_2 emitters

[1] Dr Richard Murray is a consultant on liability dynamics and other liability issues to a number of organizations including the Geneva Association (http://www.genevaassociation.org).

for global climate change. By internalizing the cost of risk and the cost of waste, economic actors selling performance have an economic incentive to prevent any future liability after the point of sale.

Furthermore, in times of rising resource prices as forecast (see the next section), corporations retaining ownership of their goods and embedded resources over the full life of their products gain a high future resource security and resource price guarantee and a competitive cost advantage against throughput-based competitors, according to the motto: 'the goods of today are the resources of tomorrow at yesterday's prices'.

(c) Buying performance as new green public procurement policy

On the demand side, the equivalent strategy to selling performance is buying performance. Buying goods as services creates the same resource efficiency advantages and can be regarded as a new green public procurement policy. Buying services instead of hardware is the preferred procurement option of parts of the US administration, such as NASA and the Pentagon, and has sparked a number of innovative start-up companies. NASA now buys exclusively orbital services from companies such as Space-X; the space shuttle was the last NASA-owned and operated hardware to provide Earth orbit services.

Michelin provides tyre-use services to all parts of the US armed forces: for aircraft tyres, a fee per landing is charged; vehicle tyres pay a fixed fee per 100 miles. This service of 'pay by the mile' is now also offered to French and US fleet managers of lorries, using a business model of mobile tyre service workshops to make tyres last as long as safely possible (http://www.michelintruck.com/michelintruck/services/MichelinFleetSolutions.jsp).

(d) Impacts of sustainable taxation on retained ownership and selling performance

Retaining resource ownership is best done by selling performance, which means reaching down to the customer in a local context, which is a labour-intensive business model. Not taxing work thus has a positive impact to foster a generalization of this business model.

Taxing the consumption of non-renewable resources will give corporations retaining the ownership of their products, and applying good resource husbandry and waste prevention, a financial bonus and increase their competitiveness.

(e) Impacts of retained ownership and selling performance on material efficiency

In a performance economy, the price per service unit is contractually fixed. The motto therefore is 'to increase your profit, decrease your losses'. By internalizing the cost of risk and of waste, economic actors have strong economic incentives to prevent losses and waste, to promote sufficiency and loss and waste prevention, and to minimize resource consumption through reuse and service-life extension activities. All of these approaches inherently increase material efficiency.

7. Policy for material efficiency: the role of sustainable taxation and sustainable framework conditions

This section defines the sustainable tax and how it influences material consumption. The proposed sustainable tax offers a way out of the present transition period of contradictory policies. The circular economy substitutes manpower for energy and material; sustainable taxation is a powerful lever to accelerate its spreading throughout the economy.

Sustainable politics should build on simple and convincing principles, such as 'do not tax what you want to foster, punish unwanted effects instead', and it should promote solutions with an embedded sustainability. Ideally, sustainable solutions create self-reinforcing virtuous circles, which guarantee their longevity.

(a) Sustainable taxation

Not taxing renewable resources including work and taxing non-renewable ones instead would create virtuous self-reinforcing circles, by creating incentives to work more (no penalty for higher income) and by creating more wealth from less new resource input (increasing caring in resource use including long-term resource ownership).

Sustainable taxation should reward desired developments and discourage unwanted effects of activities. In a sustainable economy, taxes on *renewable* resources including work—human labour—are counterproductive and should be abandoned. The resulting loss of state revenue could be compensated by taxing the consumption of *non-renewable* resources in the form of materials and energies, and of undesired wastes and emissions. Such a shift in taxation would promote and reward a circular economy with its local low-carbon and low-resource solutions. These are inherently more labour-intensive than manufacturing because economies of scale in a circular economy are limited. Taxes on non-renewable resources could be charged in a similar way to today's value added tax (VAT), also for imported goods.

Economic success does not depend on income taxes. Florida and Texas, the new powerhouses of the US economy, are two of the eleven US states that do not tax labour income; other nations and states have economic problems despite heavily taxing human labour. Germany receives one-third of its total tax income from labour (wages), another third from VAT, but less than 10 per cent from non-renewable resources.

And not taxing human labour would considerably reduce tax administration—labour tax is based on a large number of small incomes—and reduce incentives for black work in the shadow economy, which accounts for a double-digit percentage of many national GDPs.

The intelligent use of human labour has traditionally been discouraged through taxation, whereas the waste of it has been 'encouraged' in some industrialized countries through generous welfare. This shows that the role of work as a renewable resource in the economy has been misunderstood by policymakers.

Past initiatives for a more environmental and social taxation have been promoted for some decades by socialist politicians gathered in the *Ökosoziale Marktwirtschaft*[2] especially in Germany and Austria. Also compare von Weizsäcker *et al.* [30], Ekins & Speck [31] and Rechsteiner [32]. As most of these initiatives have a 'green-socialist' flavour, they were never adopted by a political majority or a majority of economists (see Sinn [33]).

The present proposal is based on sustainability and the clear distinction between renewable and non-renewable resources, which is not politically biased, and on a fair treatment of labour as a sustainable resource. The redistribution effect of present labour taxes and other governing issues [34] can be solved using other mechanisms.

Schöb[3] has pointed out that the sustainable taxation proposed in this paper does not directly help the unemployed nor the retired. The economic situation of these people would be better served by a guaranteed minimal income scheme, proposed, for instance, by Ekins [35] 30 years ago. Sustainable framework conditions are therefore not limited to the proposals in this paper.

(b) Sustainable framework conditions

The forerunner of a policy framework promoting the circular economy is in the 2008 EU Waste Directive [36]. In chapter I, article 4, it defined the new waste hierarchy of:

(i) Prevention: measures taken before a substance, material or product has become waste, including through the reuse of products or the extension of the life span of products (including waste oils), i.e. repair, remanufacturing, reuse: any operation by which

[2] Forum Ökologisch-Soziale Marktwirtschaft e.V. (FÖS), Green Budget Germany, Berlin (http://www.foes.de).

[3] Dr Ronnie Schöb, Professor at the School of Business and Economics, Chair of International Public Economics, Freie Universität Berlin. Presentation at the Zeppelin University Friedrichshafen, Germany, on 23 March 2012. For a list of his publications, see http://ideas.repec.org/e/psc185.html#top.

products or components that are not waste are used again for the same purpose as originally.
- (ii) Preparing for reuse: checking, cleaning or repairing recovery operations, by which products or components.. .are prepared so that they can be reused. Reuse and repair networks: Member States shall take measures to promote the reuse of products and preparing for reuse activities.
- (iii) Recycling.
- (iv) Other recovery, e.g. energy recovery.
- (v) Disposal.

For the first time, lubrication (engine) oils are included in the 2008 Waste Directive and no longer treated in separate legislation. They are thus subject to the same priorities of reuse and service-life extension, for instance, through re-refining.

Priorities (i) and (ii) correspond to the smallest and most profitable loops of the circular economy (see figure 1), which also have the highest material efficiency—a perfect marriage of economy and ecology.

Furthermore, sustainable framework conditions should treat the circular economy on its own merits, by

- (i) not charging VAT on such value preservation activities as reuse, repair and remanufacturing, with the possible exception of technologic upgrading activities. Major re-marketing activities, such as flea markets and eBay, are already de facto exempt from VAT and
- (ii) giving carbon credits for the prevention of GHG emissions, not only for their reduction. The small loops (figure 1) constitute a prevention of GHG emissions (and waste) but receive no carbon credits under any of the existing or planned GHG emission programmes, such as the Kyoto Protocol, which are based on the linear thinking of the industrial economy: first pollute, then reduce pollution to receive carbon credits!

(c) Transition periods

Transition periods are characterized by a contradiction of old and new policies, such as waste legislation and economic growth imperative: the 2008 EU Waste Directive prescribes the priority of waste prevention (through reuse and extension of service-life of goods), whereas the growth imperative drives policies such as 'cash for clunkers' (subsidies for the destruction of cars in working order under the condition of purchasing a new car).

Another contradiction has been quantified in a recent study by the Organization of Economic Co-operation and Development (OECD), Paris and the International Energy Agency, Paris [37]. Governments and taxpayers spent about half a trillion US dollars in 2010 supporting the production and consumption of fossil fuels. Removing these inefficient subsidies would reduce national spending and GHG emissions. 'As governments look for policy responses to the worst economic crisis of our lifetimes, phasing out subsidies is an obvious way to help governments meet their economic, environmental and social goals,' said OECD Secretary-General Angel Gurría when presenting the report to the press. Annual fuel subsidies in the EU amount to €56 billion, according to Janez Potocnik.[4]

(d) The impacts of sustainable taxation on public policy

Sustainable taxation could be an elegant and future-building way to exit the present transition period with its contradictory policies and create a stable new economic base by promoting the low-carbon low-resource circular economy.

[4]Janez Potocnik, European Commissioner for the Environnement, at a conference at Brussels on 23 December 2011.

This change is facilitated by the fact that a circular economy needs no subsidies, in contrast to many 'green' technologies, and no detailed regulation; and it lowers consumer prices and thus dampens inflation.

(e) The impacts of sustainable taxation on material efficiency

Not taxing labour increases the competitiveness of labour-intensive activities of the regional circular economy compared with the global industrial manufacturing; regional activities mean less transport volumes and shorter transport distances in the processing chain.

Applying the principles of sustainability to the economy means decoupling wealth and welfare (stock) from resource consumption (flow). A shift in taxation from renewable resources including work to non-renewable ones will boost regional job creation, employment and occupation of all forms in labour-intensive industrial and service sectors. The competitiveness of labour-intensive activities in the circular economy will increase, leading to the adoption of corporate strategies of 'repair instead of replace' in, for instance, insurance. But sustainable taxation will also make other labour-intensive activities based on 'caring' cheaper and more accepted in society.

8. Why change to a sustainable taxation now?

A number of societal changes, which have taken place in the last decade of the twentieth century and the first decade of the twenty-first century, have made the shift from a global linear industrial to a regional circular economy increasingly interesting for industrialized countries. Some of them are sketched out in the following.

The linear industrial economy is best in overcoming situations of scarcity of food, goods and shelter. But in a *situation of saturated markets*, a circular economy is best suited to manage existing stock. In 1980, the market penetration for durable household goods in France was already above 90 per cent for all social classes [38]. In Germany, from 1995 onwards, the number of cars scrapped each year has roughly been the same as the number of cars newly registered. Continued production in saturated markets constitutes a substitution of, not an addition to, wealth, at the cost of 'intensive and often inefficient use of resources' [1].

For the last 100 years, resource prices for energy and material have constantly decreased; maintaining ownership of materials to assure access to future resources made little sense. At the beginning of the twenty-first century, this trend has changed, and it is expected that resource prices in the twenty-first century will constantly increase—a theory formulated by experts at the European Commission and prominently by the asset manager Grantham [39] who called it 'the big paradigm shift'. *Resource security* could therefore become a major political bone of contention; and economic actors maintaining resource ownership will enjoy a certain guarantee of resource availability and price in the future, at the same time providing resource security for nations.

The increase in Germany's GDP from 2000 to 2007 was €381 billion, which is the same figure as the increase in German sovereign debt in the same period, according to Uchatius [40]. GDP *growth* may thus not have been created by the economy but by the increase in sovereign debt. Austerity measures to reduce government spending without changing the foundation of the economy, to increase jobs and wealth (stock) instead of increasing growth (flow), might lead to prolonged economic and social problems. The situation in other industrialized countries may be similar—but growth was not in the centre of this paper.

Persistent unemployment in many countries is still above the 'comfort level', with the percentage of unemployed youth considerably higher than of the population as a whole. According to OECD [41] latest figures, EU youth unemployment is 20 per cent, and in Spain and Greece it is above 50 per cent. This constitutes a Damocles' sword for societal development, and job creation has periodically been declared a political imperative in many industrialized countries in reaction to persistent unemployment.

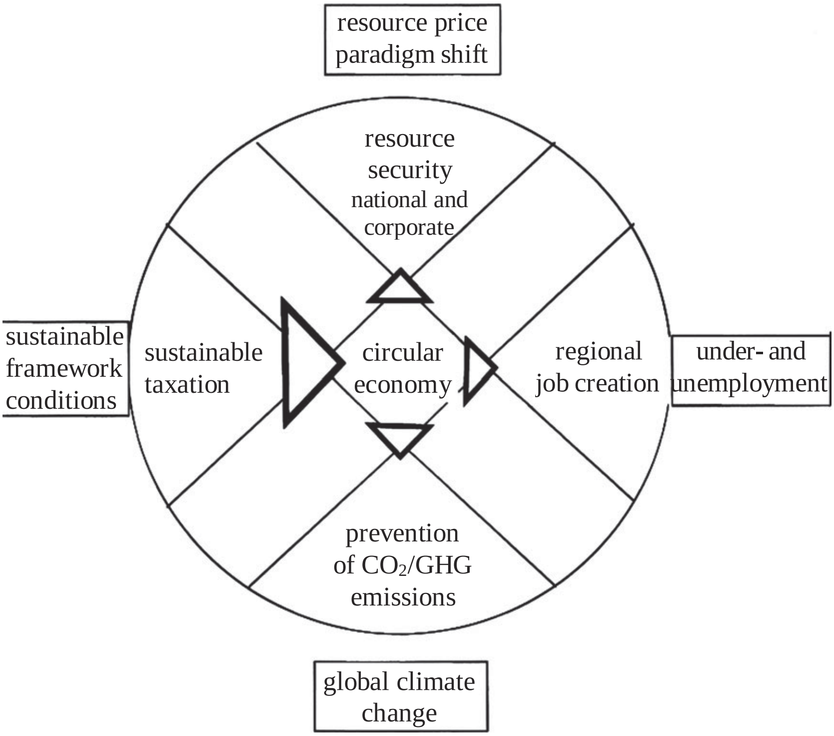

Figure 2. Sustainable taxation will promote the circular economy which in turn boosts resource security, regional job creation and the prevention of GHG emission.

The necessity to mitigate global climate change was mentioned at the 1972 UN conference in Stockholm, and recognized at the 1992 UN conference in Rio. GHG emissions have been identified by the UNFCCC as the main culprit; as well as the fact that they are partly human induced. The Kyoto Protocol was formulated to mitigate climate change and *reduce* CO_2 *emissions*. However, in 2011, GHG emissions were at an all time high and growing faster than the economy.

This paper has shown that the circular economy simultaneously increases future resource security, creates regional jobs at all skill levels and substantially reduces CO_2 emissions, by reducing resource consumption and thus raising material efficiency.

A sustainable tax policy of not taxing renewable resources including work constitutes a very powerful lever to accelerate, boost and generalize the circular economy and its positive impacts on resource security and regional job creation, while simultaneously reducing GHG emissions, as summarized in figure 2.

To summarize, the present economy is not sustainable with regard to its *per capita* material consumption. A dematerialization of the economy of industrialized countries can be achieved by a change in course, from an industrial economy built on throughput to a circular economy built on stock optimization, decoupling wealth and welfare from resource consumption while creating jobs in a number of economic sectors. The shift to a tax system of not taxing renewable resources including human labour—work—but taxing non-renewable resources instead is a powerful lever to shift to a durable circular economy by creating virtuous self-reinforcing circles that give people incentives to work more and by creating more wealth from less new resource input.

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FULL PAPER

Towards a Circular Economy Taxation Framework: Expectations and Challenges of Implementation

Leonidas Milios[1]

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Abstract
The transition to a circular economy is a complex process requiring wide multi-level and multi-stakeholder engagement and can be facilitated by appropriate policy interventions. Taking stock of the importance of a well-balanced policy mix that includes a variety of complementing policy instruments, the circular economy action plan of the European Union (COM(2020) 98 final) includes a section about "getting the economics right" in which it encourages the application of economic instruments. This contribution presents a comprehensive taxation framework, applied across the life cycle of products. The framework includes (1) a raw material resource tax, (2) reuse/repair tax relief, and (3) a waste hierarchy tax at the end of life of products. The research is based on a mixed method approach, using different sources to analyse the different measures in the framework. More mature concepts, such as material resource taxes, are analysed by reviewing the existing literature. The analysis of tax relief on repairs is based on interviews with stakeholders in Sweden, where this economic policy instrument has been implemented since 2017. Finally, for the waste hierarchy tax, which is a novel proposition in this contribution, macroeconomic modelling is used to analyse potential impacts of future implementation. In all cases, several implementation challenges are identified, and potential solutions are discussed according to literature and empirical sources. Further research is required both at the individual instrument and at the framework level. Each of the tax proposals needs a more detailed examination for its specificities of implementation, following the results of this study.

Keywords Circular economy · Economic policy instruments · Resource tax · Resource efficiency · Waste tax

* Leonidas Milios
leonidas.milios@iiiee.lu.se

1 International Institute for Industrial Environmental Economics, Lund University, P.O. Box 196, 22100 Lund, Sweden

Introduction

Over the last decades, a continuously expanding global economy has put stress on the earth's natural resources, raising concerns about increasing adverse environmental impacts and impending resource shortages [1]. To mitigate the potential overexploitation of resources and the associated environmental damage, the promotion of circular material use (including the reduction of material input, as well as reuse and recycling) is necessary for reducing the generation of waste and the economy's dependence on the extraction of primary raw materials [2, 3].

National governments and supranational governance entities, such as the European Union (EU), are gradually integrating such resource concerns into their policy agendas. The strategic direction of the EU has progressively focused on increasing resource productivity and innovation in the economy, aiming at the efficient and effective use of resources, sustained economic growth and job creation, with less environmental impact [4]. One of the basic premises of the recently proposed 'Green Deal' for Europe is the promotion of the circular economy [5].

The circular economy (CE) aims at maximising the value and utility of resources and energy within production systems, based on the premise that natural resources are scarce and that products at their end of life (EOL) may retain some value [6]. Having its roots in industrial ecology and environmental economics [6, 7], the CE is not a solidly defined concept but follows a few general principles that remain constant in all definitions available in literature. Total material use reduction; reuse of products by extension of product life through repair, refurbishment and remanufacturing; recycling; and recovering materials in production and use processes constitute the basic elements of CE [8]. Moreover, CE is operationalised at multiple levels, the micro level (products, companies, customers), meso level (eco-industrial parks, economic sectors) and macro level (region, nation and beyond) [6, 8].

The shift to a circular economy is a complex process requiring a wide multi-level and multi-stakeholder engagement from all parts of society [9]. Therefore, realising a systemic shift by employing an individual policy instrument may prove to be insufficient. Applying just one policy instrument would most likely change an individual driver, failing to address the issue holistically [10]. Consequently, a more complex approach would be required by developing a mix of policies that targets the multi-faceted aspects of a circular economy transition.

The policy instruments that are available in the arsenal of governments to lay down the enabling conditions for a circular economy can be generally distinguished between three broad categories: administrative (e.g. regulatory bans, standards, targets), economic (e.g. taxes, tariffs, subsidies) and informative (e.g. labels, certifications, information campaigns). These can be of mandatory or voluntary nature [4, 11].

To address the CE holistically, the European Commission takes a life-cycle approach in designing policy proposals that target specific aspects of production, consumption and waste management. This is documented in the EU Circular Economy Action Plans (COM(2015) 614 final and COM(2020) 98 final), where several policy instruments at different life-cycle stages are included. So far, the focus was mainly on direct administrative interventions, backed by informative instruments and tools, while the potential of economic instruments for a circular economy was not addressed adequately [4, 12]. Taking stock of the importance of a well-balanced policy mix that includes a variety of complementing policy instruments, the latest CE Action Plan (COM(2020) 98 final) includes a section about "getting the economics right" in which it encourages the broader application of economic instruments, such as environmental taxation (including waste taxes), and enables EU Member States to use variable value added tax (VAT) rates to promote circular economy activities that target final consumers, notably repair services.

Although environmental taxes are addressed in literature regarding the potential effects on resource savings, e.g. [13, 14], in practice the preference of such measures seems to be limited [15]. Material resource taxes internalise the environmental and social externalities of resource extraction [16] but are considered only as second-best policies for addressing resources [17] due to their "inherent impreciseness" [18]. There are multiple structural barriers connected to the design, implementation and administration of resource taxes, as well as information barriers and split incentives between the actors involved. Therefore, resource taxation is "implemented on an exclusively selective basis and cannot be considered as sending a clear-cut signal to economic actors" [18]. Apart from resource taxes, proposed tax reductions for repair services have not been thoroughly assessed for potential effects, as their limited application and tax base so far indicate high administrative costs.

To date, the research related to appropriate policy interventions for a resource efficient CE is limited, and only a handful of articles offers insights to the necessary policy instruments for comprehensive CE policy mixes, e.g. [10, 12, 19]. Moreover, the majority of policy instruments presented in previous research is either administrative or informative in nature, largely disregarding the potential of economic policy instruments to contribute in the CE policy mix. The policy measures either derived from existing policy approaches (e.g. eco-design and green public procurement) or constituted novel propositions for consideration by policymakers (e.g. reuse targets and reuse quality labelling), and fiscal measures in the policy mix played only a minor role.

This contribution aims at complementing previous research by developing a fiscal framework for CE, based on resource, product and waste taxation. The framework is developed independently in this article, but it has the potential to be integrated in existing policy approaches as a supporting (market-based) mechanism. The framework takes into consideration the different life-cycle stages of products, from resource extraction and input to waste disposal—or EOL stage. By following this life-cycle modular approach, the framework is compatible to similar approaches in CE policy development and can be implemented holistically or partially, depending on the life-cycle stage that needs market-based support. Moreover, the objective of the article is not only to introduce the framework but also to scrutinise its potential and analyse the challenges of its implementation.

The overall aim and the objective of this contribution guided the research approach which is formulated in two research questions: (1) How does a fiscal policy framework for CE can be constructed to address resource efficiency in a life-cycle perspective and what instruments would be appropriate to include? (2) What is the potential effectiveness of a fiscal policy framework for CE?

In the following section ("Circular Economy Taxation Framework" section), the Circular Economy Taxation Framework is presented together with the rationale of developing this framework based on literature insights. The "Methodology" section provides an overview of the different methods used to derive the conceptual taxation framework and to analyse the potential and implementation challenges of the different elements of the framework. In the "Results and Discussion" section, the research results are presented and analysed in a comprehensive discussion, and finally the "Conclusions and Future Research" section concludes the paper and provides suggestions for future research.

Circular Economy Taxation Framework

The Circular Economy Taxation Framework constitutes a comprehensive fiscal policy approach targeting each of the life-cycle stages of a product with a different policy intervention. The framework includes three life-cycle stages: (1) production, (2) product use and (3) waste management. For each stage, a different taxation approach is used to reflect more accurately the desirable resource efficiency outcome. Figure 1 illustrates the different elements of the framework.

Production Stage of the Life Cycle

In the production stage, a natural (virgin) raw material resource tax is proposed. Raw material resource taxes can be applied at different stages of the production process: (a) at the stage of extraction of the raw material, (b) at the input of the material at the first industrial use and (c) at the final consumption stage of products with embedded material content [20]. The design of this intervention is not explicitly defined within the proposed framework, leaving room for policy decision-makers to adapt the application of the tax according to the most appropriate circumstances in their respective jurisdictions. The different application approaches are discussed in further detail in the "Results and Discussion" section of this article.

From a public policy perspective, a tax on raw material resources can be motivated by both fiscal and environmental arguments [18]. From an economic point of view, a tax on raw material resources can be motivated either due to a market failure in which market forces are not effectively capturing the associated environmental externalities of resource extraction and use or in the case that other environmental regulations (e.g. pollution mitigation) are not effective in addressing the relevant market failure better than a tax [21]. Further, Söderholm [17] motivates the decision of adopting raw material taxes on (a) concerns of resource depletion, (b) addressing environmental externalities, (c) the expectation of future amounts of emissions or waste (which a tax on raw material inputs could prevent downstream) and (d) a way of encouraging the substitution of virgin material resources with secondary and recycled materials.

Radetzki [22] has demonstrated that demand for raw material resources tends to be own-price inelastic, especially in the short run. This is partly because there are usually few substitutes to a given resource, and due to the intense extraction and processing of natural resources (e.g. metal smelting), which makes the substitution to other raw material input too costly and time-consuming. Therefore, the application of a tax on primary raw material resources might induce a demand for secondary material resources—where readily

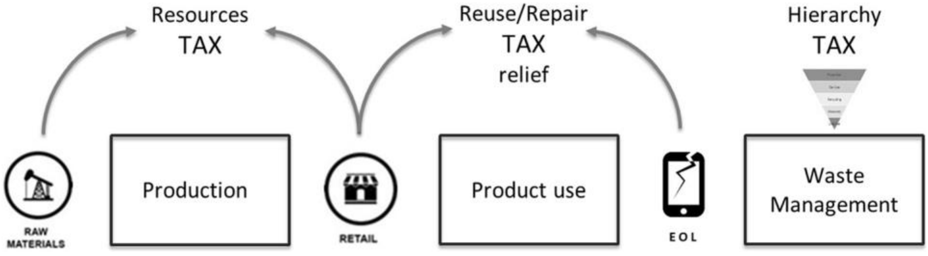

Fig. 1 Circular Economy Taxation Framework including (1) a natural raw material resource tax, (2) reuse/repair tax relief and (3) a waste hierarchy tax at the end of life of products

available—provided that the level of the tax is high enough to at least balance the difference of prices between virgin raw materials and secondary materials (exempt of tax), which could lead to increased circularity in production systems. However, Söderholm [17] concluded that virgin material taxes may lead only to limited use of secondary raw materials since the own-price elasticity of supply for these alternative materials typically is very low.

In terms of macroeconomic fiscal policy, the demand for raw materials is typically indirect, i.e. the demand occurs due to the volume of consumer goods produced by the given materials. Therefore, raw material resources form the basis of economic activity and are likely to continue to do so in the future. Thus, the long-run price elasticity of demand may be considered low, and raw material resources could thus represent a stable tax base for governments [15, 17].

Use Stage of the Life Cycle

In the product use stage, a reuse/repair value added tax (VAT) relief is proposed. This is a generally accepted tax intervention which aims at increasing the affordability and availability of repair services and at boosting the uptake of reuse as a significant option in consumers' decisions concerning their old products. Therefore, a reduced VAT rate on repairs could increase the ability of local shops to offer repair and maintenance services, which are in line with the goal of increasing resource efficiency in the economy as whole.

The EU CE action plan (COM(2015) 614 final) states that "price is a key factor affecting purchasing decisions, both in the value chain and for final consumers. Member States are therefore encouraged to provide incentives and use economic instruments, such as taxation, to ensure that product prices better reflect environmental costs. […] Once a product has been purchased, its lifetime can be extended through reuse and repair […]. The reuse and repairs sectors are labour-intensive and therefore contribute to the EU's jobs and social agenda". It is also important to mention that in the EU, small- and medium-sized enterprises (SMEs) represent more than 95% of all firms and provide more than 67% of total employment [23]. SMEs can play an important role in a CE transition by providing sustainable, yet labour-intensive services such as repair and refurbishing [24].

Reduced VAT rates for repair and reuse can also address externalities. By prolonging the life of products, significant savings in material and energy use can be achieved [25] and partially offset new production of consumer goods [26]. Moreover, reduced VAT rates are not expected to have negative implications for the functioning of the internal market as the relevant products and services are typically not traded across EU borders [27].

Despite the perceived benefits of reduced VAT rates for repair and reuse, there is a lack of real-life examples of implementation. One exception is the government of Sweden, which in January 2017 introduced a tax reduction on repair of certain products. The VAT rate on repair was reduced from 25 to 12% for products such as textiles, shoes, leather products and bicycles. The aim of the reduction was to encourage reuse and repairs [28]. Another instance of tax reduction in Sweden includes a deduction of 50% (RUT tax deduction) on the labour costs for home repairs and maintenance and was first implemented in 2007 and updated in 2016 [29]. The updated version was implemented in 2017 together with the VAT reduction for repairs (Revision 2016:1055 of the income tax law 1999:1229).

Although the design and implementation of this taxation incentive has not been studied extensively, it consists an integral part of the proposed Circular Economy Taxation Framework that can succinctly address the issue of repair and reuse of products at the use stage of the life cycle. Aided by the Swedish example of implementation, the anticipated results and effectiveness of this policy intervention are discussed in the "Results and Discussion" section.

End of Life Stage of the Life Cycle

In the EOL stage, a "waste hierarchy tax" is proposed, i.e. a progressive tax which follows the "waste hierarchy" principle, with the tax rate decreasing progressively from landfilling (highest) to recycling (lowest), and is set to zero for any level above recycling.

Palmer and Walls [16] suggest that a tax on virgin raw materials can only correct the external costs resulting from extraction processes, but not external costs resulting from waste disposal. Additionally, no single tax can generate an optimum level of both downstream and upstream impacts, so multiple policy instruments would be necessary to fully internalise these externalities [30]. Therefore, it is considered imperative to complement the raw material resource tax and repair/reuse VAT relief with a waste tax that accounts for externalities at the EOL of products.

A common approach that has been extensively used in EU Member States (MS) is the so-called landfill tax. A review of the waste management performance of all MS over the period 2001–2010 [31] has concluded that landfill taxes played a major role in improving the waste management practices in MS and enabled them to divert considerable amounts of waste away from landfills to other more environmentally sound waste management options, according to the principles of the "waste hierarchy". The waste hierarchy constitutes the central principle of EU waste management, as it is expressed in Article 4 of the Waste Framework Directive (2008/98/EC). The waste hierarchy addresses the prioritisation of waste management options according to environmental and resource efficiency aspects. It includes the following waste management operations: (a) waste prevention; (b) reuse and preparation for reuse; (c) material and biological recycling; (d) energy recovery from waste; and (e) disposal to controlled or uncontrolled landfills, land or water.

Following the reasoning of implementing landfill taxes in EU MS and the observed results of the tax in diverting waste towards higher stages of the waste hierarchy, notably energy recovery and material recycling [31], a waste hierarchy approach is proposed to complement the Circular Economy Taxation Framework. According to the logical reasoning, since a tax on landfill made it uneconomical to dispose waste in landfills, a similar (but proportionately lower) tax on waste to energy (WTE) incineration would divert waste from incineration to recycling. Finally, a tax on recycling of waste would make the "preparation for reuse" and reuse of EOL products the most economically desirable option. However, under the condition that the tax is high enough to offset costs from other waste treatment options. That is to say, that after the implementation of the tax, landfilling becomes too costly compared to incineration, and respectively incineration is too costly compared to recycling. There are only a few examples of incineration taxes imposed on top of landfill taxes in MS, but the effectiveness of these to divert waste towards recycling has been inconclusive. For instance in Sweden, the incineration tax was evaluated as inefficient and counterproductive since it did not lead to the anticipated waste diversion and lead to increased waste fees and energy prices for the municipalities [32]. Taking this into account, it is important to set the tax rate quite high so as to overcome price levelling by energy sale revenues.

Moreover, environmental and social conditions must be taken into account when designing the tax architecture within a sustainability context. Although the tax level would be signalling the preferential waste management option according to the waste hierarchy, it might be necessary in certain occasions to depart from the hierarchy in accordance to the provisions of the Waste Framework Directive (2008/98/EC). In Article 4 of the Directive, it is stated that the preferred waste management option is the one that delivers the best overall environmental outcome, taking into account general environmental protection principles, technical feasibility and economic viability, the protection of resources as well as the overall human health, economic and social impacts. For instance, in some cases, incineration might be more economically viable than landfilling after introducing the suggested tax measures, but simultaneously it might be comparatively environmentally inefficient or even more polluting than landfilling, depending on the nature of the material, and it may result into serious environmental and social side effects (e.g. health concerns in urban areas).

Finally, it is worth noting that although the waste hierarchy is addressing waste management, step (a) waste prevention and partially step (b) reuse and preparation for reuse of the hierarchy deal mainly with non-waste. Waste that is prevented is waste not generated, and reuse of a product means that the product did not become waste in the first place [33]. Therefore, within the "waste hierarchy tax", any treatment option higher than recycling is not subject to a taxation rate.

Concluding the "Circular Economy Taxation Framework" section, environmental taxes in general are considered to be "growth-friendly", as they are less distortive compared to taxes on labour and income, while the administration and transaction costs of such taxes are lower than that of other taxes (notably income taxes) [15]. Furthermore, the efficiency losses from environmental taxes are far less compared to labour taxes [15].

Methodology

The research in this contribution was based on a mixed methods approach, using a variety of secondary sources, to analyse the specificities of each proposed taxation measure. Literature relevant to environmental fiscal interventions, and more precisely on material resource and waste fiscal policies, paved the way for the conceptual development of the Circular Economy Taxation Framework which is presented in the "Circular Economy Taxation Framework" section. For the in-depth analysis of the different proposed taxation measures within the lifecycle stages of the framework, a variety of research methods was necessary. More mature concepts, such as material resource taxes, were analysed based on reviewing the existing literature on the subject. The analysis of tax relief on repairs was based on the work of Almén et al. [29], who conducted interviews with relevant stakeholders in Sweden, where this economic policy instrument has been implemented since 2017. Finally, for the waste hierarchy tax—a novel proposition in the taxation framework—the analysis was based on macroeconomic modelling (computable general equilibrium model (CGE)) conducted by Lokrantz [34] to analyse potential impacts of future implementation by comparing different scenarios. More details on the methods are presented in the following paragraphs.

The literature review, interviews and macroeconomic modelling were focused on Sweden as a case study. The reason for focusing on Sweden is due to the fact that most of the proposed taxation interventions have already been implemented in Sweden to a higher or lesser degree. Natural resource taxes are implemented in Sweden, for instance in the case of natural gravel [35]. A VAT discount in repairs of products such as textiles, shoes, leather products and bicycles has been implemented in Sweden since 2017 [4], and a tax return is calculated for repairs of white goods and IT equipment at home [29]. Sweden is imposing a tax on landfilling

(500 SEK per tonne of waste) and incineration (100 SEK per tonne of waste) [36]. Thus, most of the elements included in the Circular Economy Taxation Framework proposed in this contribution have been implemented in the context of Sweden, and therefore it constitutes a relevant case study to analyse in more detail. However, the Circular Economy Taxation Framework includes additional elements which have never been encountered in literature, and this is the reason for employing macroeconomic modelling and scenarios development, in the case of the waste hierarchy tax.

Starting with the natural raw material tax relevant literature was sought for, using the basic keywords “material tax”, “natural resource tax” and variations of these forms. The search was strictly limited to a narrow range of “material” taxation, because using broader terms such as “environmental tax” or “green tax” would return a large amount of literature relevant to pollution taxes. Further, natural resources such as land, water and air were excluded manually from the search results, and a strict focus was maintained around materials (e.g. metals, minerals, plastics, wood). The literature review commenced with searching for scientific publications using databases such as Web of Science, Scopus and Google Scholar. Then snowballing technique was used (in terms of keywords, authors’ names and journal titles) to expand the preliminary reference list. In addition to peer-reviewed literature, “grey” literature sources were also examined, since taxation regimes are discussed also by practitioners outside of academia. Relevant government consultation documents and consultancy reports were also included in the search results.

Almén et al. [29] developed a qualitative methodology to analyse the effects of a tax relief on repairs in Sweden by conducting semi-structured interviews with companies that perform repairs. This method was chosen for receiving a direct account of the interviewees’ own experiences and expectations regarding the repair tax deductions. The interview study followed an inductive approach with the aim to investigate and draw conclusions through the analysis of the collected data and without adopting prior theoretical hypotheses [37]. The targeted interviewees were chosen among the sectors included in the regulation (shoes, bicycles, white goods, IT equipment) and depending on whether they perform repairs or not. In total, 22 Swedish SMEs in the repair sector were interviewed. The interviewed companies included five shoe repair companies, five bicycle repair companies, five white goods repair companies and seven IT repair companies. The analysis of the interviews was qualitative based on the collected data without using any particular software for the coding of emerging themes; thus, a risk of subjectivity and analysis bias is present in the results.

For analysing the effects of a waste hierarchy tax in the Swedish economy and its resource efficiency potential, Lokrantz [34] developed a simplified computable general equilibrium (CGE) model of the Swedish economy, which was extended with equations representing waste flows and environmental preferences. The simplified model included a few basic assumptions. Firstly, the model considers a closed economy, meaning that neither international trade nor foreign influences are modelled. Secondly, the model considered a static economy in the sense that it does not include any dynamic elements like savings or investment which depends on intertemporal decisions over time. Lastly, the model assumed that there are no market imperfections, there is perfect competition and no uncertainty. The series of assumptions were considered necessary to develop a robust model that would give meaningful results without overcomplicating the economy structure.

The benchmark data for the model calibration consisted of data on quantities of treated waste and Swedish national accounts retrieved from Eurostat [38, 39]. The base year was set to 2016, which is the latest year with available data on quantities of treated waste. The waste data were organised after treatment technology and after the European Waste Catalogue's classifications of waste categories.

To discuss the different possible ways of implementation and impacts of a waste hierarchy tax in Sweden, Lokrantz [34] developed alternative policy scenarios and compared them to the baseline—the current situation in Sweden. The policy scenarios included (A) waste hierarchy tax, (B) waste hierarchy tax with a recycling subsidy and (C) waste hierarchy tax with a technology shift. The scenarios are briefly summarised below and in Table 1.

Scenario A: Waste Hierarchy Tax

This scenario was based on the waste hierarchy principle, aiming to divert waste towards recycling and eventually reuse and prevention. In this setting, the taxation framework differentiated between the different treatment technologies and ranked waste disposal, incineration and recycling according to the waste hierarchy. Hence, all levels were taxed with different tax rates, given their position in the waste hierarchy (see Table 1). Accordingly, the tax rate for waste disposal was set at 500 SEK per tonne, which is the same as the Swedish landfill tax [36]. The incineration tax and the recycling tax were set gradually lower, at 300 SEK and 100 SEK per tonne, respectively. Thereby, recycling would become more financially attractive, while harmful treatment alternatives like landfill and incineration were penalised.

Scenario B: Waste Hierarchy Tax with Recycling Subsidies

The tax on recycling was replaced with a subsidy, resulting in a policy intervention that introduces two different policy instruments. Combining taxes on waste with a subsidy is encountered by Schwerhoff and Franks [40] who combined environmental taxes with subsidies on capital and output, and based on literature about resource taxes and recycling subsidies [16, 41]. The tax rates for the different treatment technologies were the same as in the previous scenario (see Table 1), but instead of taxing recycling, in this scenario the government subsidised it. The subsidy was modelled as a negative tax [40]. With the recycling subsidy, firms were given a strong incentive to shift from waste disposal and incineration to recycling.

Scenario C: Waste Hierarchy Tax with a Technology Shift

The effect of the waste hierarchy tax was analysed in the presence of a technological improvement in the production sector. According to Böhringer and Rutherford [42], technological change plays an important role when assessing policies for circular economy and resource efficiency. This is because technological shifts can lead to more resource efficient production but can also result in a rebound effect [42]. Following this line of thought, in

Table 1 Summary of scenario settings (level of tax/subsidy expressed in Swedish currency (SEK) per unit), adapted from [34]

	Baseline	Scenario A	Scenario B	Scenario C
Disposal	0	500	500	500
Incineration	0	300	300	300
Recycling	0	100	0	100
Subsidy	0	0	100	0

response to the waste hierarchy tax reform, it was assumed that firms are willing to invest in new, more efficient technology which is captured by a shift in productivity, modelled as 10% increase in the productivity coefficient.

Results and Discussion

The results of the literature review and the secondary source material are presented and discussed separately for each tax intervention in the following subsections, followed by a separate subsection discussing the potential and challenges of the Circular Economy Taxation Framework as a whole.

Natural Raw Material Resource Tax

For a natural raw material tax to create a positive response from industrial actors or consumers, leading to more resource-efficient practices, the tax level needs to be sufficiently high regardless of where in the value chain it is applied [9, 20]. Baptist and Hepburn [43] recognise that the implementation of such a high tax rate could be extremely difficult in the real economy. The material tax in itself could be expected to have a moderate effect because own-price elasticity of demand is often low for materials [17]. This suggests that it is important to understand how a wider set of policies, in addition to the tax, interact with raw material markets [41]. Thus, the development of material taxes requires careful consideration before design and implementation. Moreover, issues related to imports and exports of raw materials may create competitiveness asymmetries and require particular attention [44].

The effects of a tax on natural raw material resources may differ according to the phase of the value chain in which it is applied. Demand-price elasticity as well as market dynamics and innovation potential can vary at different stages of the value chain of a material [20]. For a single non-renewable material resource, there are three stages in the value chain in which a tax could be applied: (a) at the extraction of the raw material, (b) as input of the material at the first industrial use and (c) at the final consumption of products (embedded material content).

A raw material tax imposed at the extraction stage in a region would directly affect the international trade of the targeted commodity. The tax would bring domestic producers at a cost disadvantage compared to foreign producers, leading inevitably to the reduction of domestic extraction, to a corresponding increase in imports and potentially—depending on demand elasticity—to price increase [41]. The increase in imports of a raw material would imply increase of production in third countries. Consequently, the tax would not have a direct effect on the extraction of the targeted material elsewhere, since the level of use in the domestic market would remain unchanged through tax-exempt imports, but the net environmental effect could possibly be negative if the extraction technologies abroad are worse than the domestic ones [20].

Therefore, it is important to introduce appropriate counterbalance measures to mitigate adverse environmental impacts of such shift in extraction location, for instance through the implementation of a border tax adjustment mechanism on imported resources [20]. In addition to neutralising the effects of the tax on domestic producers, it would also protect the competitiveness of domestic industries. However, the effect on the competitiveness of the domestic industry would be much smaller if the tax is not calculated on the basis of the quantity of materials extracted or imported, but on the estimated quantity of raw materials that are extracted globally to produce products that are used in Sweden [44]. Other measures that could potentially prevent competitiveness losses for domestic industries could be to levy the tax on materials and products used domestically in Sweden, including imported products as well as domestically produced products, but to exempt materials produced in Sweden for export [44].

Another option for implementing a material tax is that of a “material input” tax, which means tax levied at the resource input of manufacturing (the first time a material is used). It differs from a resource tax at the extraction stage, as a supplementary border adjustment tax is not needed because this type of tax does not distinguish between domestic and imported materials. In order for such a tax to be reasonably implemented, the main requirement would be that there is a limited number of product groups subject to this tax; otherwise its implementation would be challenging [20]. A material input tax could, instead of encouraging substitution of the taxed material, stimulate technological innovation aimed at reducing the use of that material, for instance be “light-weighting” which would be favourable in terms of resource efficiency [45].

The last possible stage for introducing a raw material tax is at the final use of products. Tax on the consumption of products that include large amounts of a specific resource is possible; however, its application might prove rather challenging and its effectiveness uncertain. There could be significant problems in identifying the share of a specific material within a final product, making the taxation base uncertain [20]. Taxation at this stage might be better thought of as a tax based on the intensity of multiple materials, possibly taking a life-cycle analysis (LCA) perspective. Andersen [46] argues that once reasonable estimates are available for the external costs of a product, it would be possible to internalise these in market transactions by introducing relevant environmental taxes and charges. This allows for a first theoretical approach on the application of a PEF-based (Product Environmental Footprint-based) taxation structure. The latter would be interesting to investigate further; however, the sheer amount and diversity of products and product groups would be a formidable challenge, to say the least.

Increasing material recycling is a basic principle of resource efficiency [3]. Taxation schemes based on material input or consumption taxes would ideally target only virgin materials, and not their recycled equivalents. This could pose challenges in designing taxes for certain materials (e.g. metals, paper) as their recycling rates are already quite high [20]. Furthermore, due to global recycling markets, recycled metals such as iron could be easily integrated into intermediate products and parts, and their detection in final products would be difficult. Ekvall et al. [9], on the other hand, suggest that the tax should be applied also on recycled materials, since the overall aim of such a tax would be to increase material efficiency, and therefore the reduction of material input regardless if the material is virgin or recycled. Moreover, a material tax should be levied on all types of materials in order to avoid burden shifting between materials. It could be levied even on renewable materials, as renewable resources need also to be used efficiently, because their production rate is limited [9].

The possibility of substitution constitutes a critical factor for the effectiveness of resource input and consumption taxes and forms a major drawback if designed to address a single material resource. Taxing a single material might result in substitution rather than overall resource efficiency [45]. Moreover, substitutes of the taxed material may have other unpredictable environmental disadvantages, such as higher energy intensity or lower recyclability [20]. Taxing material groups could be a better approach, but that might shift the problem to comparing the material groups themselves, for instance plastics versus metals, instead of single material groups, such as copper versus aluminium (i.e. metals).

A tax on material resource input on new production could contribute also in establishing a competitive advantage of second hand goods (reuse), since competing manufactured goods would have increased raw material costs and thus become more expensive [47].

Concluding, even under a trade-neutral taxation scheme, based on a material resource tax and supplemented by border adjustment countermeasures, there is still a risk of cross-material substitution effects with uncertain resource and environmental implications. However, a global multilateral extraction tax on all non-renewable and non-energy resources could be considered a viable solution, since its expected effect would lead to a global price increase of resources resulting in global demand reductions [20]. The actual design and implementation of such a resource tax, however, would be a major challenge in the current global political environment.

Value Added Tax Reduction in Product Repair and Reuse

The analysis of the “repair/reuse tax relief” component of the proposed CE taxation framework is based on the empirical study by Almén et al. [29], which aimed at assessing whether there has been a change in repair activity since the implementation of the VAT reduction and RUT tax deduction in Sweden. The focus of the study was exclusively on four economic sectors, which are specifically targeted by the tax reduction legislation (i.e. shoes, bicycles, white goods and IT goods).

Out of the twenty two interviewed companies across the four different sectors, only nine noticed an increase in the number of repairs executed since the implementation of the tax changes in 2017. Of those nine companies, two were shoe repair companies, three were bicycle repair companies, zero in white goods repairs, and four were companies that performed IT goods repairs (e.g. repairing mobile phones, computers, televisions). However, the majority of the companies could not determine if the increase was caused by the tax deductions or not. In other words, a large portion of the interviewed companies were not considerably affected by the lower tax regime for repairs. A summary of findings is presented in Table 2.

The results showed that a relative majority of companies in the bicycle and IT sector could claim an increase in the number of repairs. On the other hand, most of the companies in the other two sectors, white goods and shoes, did not observe any significant changes. There are several reasons that might explain these differences between the sectors. For instance, the reason why no changes were noticed in the white goods sector might be related to the fact that “it does not depend on whether the taxes are low or not, but rather the high purchasing price of new products”, as one interviewee highlighted. The product category of white goods can be in general more expensive than shoes, bicycles and IT goods (although some high-end IT products can be equally expensive). The difference in price between repairing existing products and buying a new product is larger, which increases the willingness to repair. Thus, the number of repairs did not increase entirely due to the effect of the reduced tax, since the majority of consumers would prefer to repair than buying new in any case.

Regarding the shoe repair sector, the reason no changes were noticed may be due to a different market situation and the view of shoes as more easily replaceable, compared to other sectors. For people to actually repair their shoes, these must be of high quality and possibly expensive for making it worth the effort to repair them. The shoe market can be both expensive and cheap depending on brand and shop, just like the other sectors. However, low-quality and dispensable shoes (according to fashion trends) are usually not worth repairing compared to expensive and “classical” high-quality shoes. One interviewee particularly stressed that the main problem can be spotted in the growing “throwaway culture”. This linear behaviour seems

Table 2 Summary of the interview results with 22 Swedish SMEs in four sectors (shoes, bicycles, white goods, IT equipment) that are eligible for repair tax reduction according to Swedish legislation

Economic sector No. of companies	Perceived tax effectiveness No. of companies (share)	Tax did not influence repairs No. of companies (share)	Possible reasons for no tax effect
Shoes – 5	2 (40%)	3 (60%)	- Shoes viewed as dispensable - Fashion/trends - Variable (low) quality of product
Bicycles – 5	3 (60%)	2 (40%)	- Variable (low) quality of product
White goods – 5	0 (0%)	5 (100%)	- High cost of new product makes repairs preferable
IT equipment – 7	4 (57%)	3 (43%)	- Lack of information about the tax
Total – 22	9 (41%)	13 (59%)	- Lack of information about the tax - Price difference of repair vs. buying new product - Variable (low) quality of product - Product design/ difficulty to repair

The table shows the percentage of companies that experienced increase in repair services as a consequence of the tax, and the main reasons why the rest of the companies did not experience any effect of the tax

to be embedded in the purchasing decisions of Swedish consumers, and in this regard, the implementation of the VAT reduction did not have a noticeable impact on the interviewees' businesses. This may imply that further policies and/or initiatives might be required to address such behavioural inconsistencies that cannot be tackled just by the implementation of a reduced tax rate for repairs.

In order to address the reasons behind the observed limited effectiveness of the tax reduction in increasing repairs, it is essential to identify the barriers for repair in the current situation. Barriers that were highlighted by the interviewees in all the above sectors included (a) lack of knowledge regarding the reduction of the tax for repairs, (b) the difference in prices between repairs and buying of new products, (c) perceived and actual product quality and (d) product design, which makes it difficult to repair products and to access spare parts.

Interviewees from all sectors, except the bicycle sector, mentioned that there is a lack of knowledge regarding the existence of a tax reduction among their customers and that it is unlikely that the majority of their repair operations can be attributed to the tax reduction. On the other hand, in the bicycle sector that the tax reduction was more prominent, after an initial spike on repairs by the time of the introduction of the tax reduction, repair activities have levelled off gradually and now bicycle repairers cannot see a difference compared to the level of repairs before the VAT reduction.

It is therefore of paramount importance to communicate the tax reduction intervention better with the public and to disseminate more information about the nature and the benefits of repairs. The information should be aimed at the people who are not aware that there is a possibility to repair products at a cheaper price compared to before the VAT reduction was implemented.

Another identified barrier was the relatively low purchasing price of new products compared to the cost of repair, which deterred customers from repairing their product instead of buying a new one. In addition, the quality of products plays a significant role in the decision whether a product is worth repairing. Two of the interviewees in the bicycle sector stressed that high-quality bicycles are worth repairing compared to low-quality bicycles, which are viewed as disposable and are not worth the effort (time and money) to repair. This applies on products in all sectors. If consumers turn to buying more high-quality products, the chance that they will see worth in repairing the product increases. Therefore, by widening the price gap between a new purchase and the repair of already acquired products would increase the willingness to repair by the customer.

Moreover, the quality of the repair work is critical for the wider uptake of repair activities. The price of a new product usually includes a guarantee that the product will function according to quality specifications for a certain amount of time; otherwise the customer has the right of refund or replacement [48]. In the case of repairs, this is not the standard practice and it could act as a deterrent for repairs even through the price would be lower compared to buying new. Therefore, another proposed solution mentioned by one of the bike repair companies was a certification among workshops. This could lead to an increase in the number of repairs since customers will know that the repair is of high quality. This is reiterated in literature, also in the case of IT goods [49], where a quality labelling scheme can potentially boost consumer confidence in repairs.

Finally, to facilitate easier and more cost efficient repair services, the products should be easier to disassemble and contain less diverse and hazardous materials. For instance, an interviewee in the shoe repair sector mentioned that "high quantities of plastic in the shoes make them harder to repair or not repairable at all". Therefore, the selection of materials and product design can have significant effect on the feasibility and the cost of repair, which in turn would negate the effect of a tax reduction no matter what the level of the tax and the potential gain would be. Related to product design and the feasibility of repairs, another aspect which needs to be considered is the availability of spare parts. If consumers choose to keep their old product for a long time, repairers may not have the spare parts needed due to the discontinuation of a certain product/model in the market. This is a barrier especially relevant for IT products where the development of new products is progressing rapidly. Therefore, availability of spare parts in the market and at reasonable (affordable) price is a prerequisite for a well-functioning repair sector [50], which can benefit from a tax reduction.

Concluding, the implementation of a tax reduction on repairs of certain products (i.e. shoes, bicycles, white goods, IT goods) in Sweden since 2017 did not have a significant impact according to the study by Almén et al. [29]. Some companies in the bicycle and IT goods sectors observed an increase in the number of repairs; however, the majority of the interviewees could not link the increase in repair frequency to the respective tax reduction. The implementation of the tax reduction for repairs did not have the desired effect so far. This may imply that further policies and/or initiatives are needed as the effect of the repair tax reduction alone is not expected to result in any significant changes in consumer behaviour.

Waste Hierarchy Tax

For the quantification of the effects of a waste hierarchy tax in the Swedish economy and its associated resource efficiency implications, Lokrantz [34] developed and applied a static, closed economy CGE model for Sweden. The quantitative nature of CGE models are appropriate tools for assessing such policies as they allow for quantifying the effects of the waste hierarchy tax on the relation between the waste and the macroeconomy. By evaluating the introduction of a tax based on the waste hierarchy principle under different scenarios—as presented in the method section of this article—the conditions in which the tax has a positive or negative impact on the Swedish economy can be analysed.

The main results of the CGE modelling are presented in Table 3, where the different scenario equilibrium solutions are shown as the percentage change from the baseline. This convention simplifies the presentation of the results and makes it easier to compare the scenarios' results.

The simulation results for Scenario A change significantly from the baseline. The results show that introducing a waste hierarchy tax can lead to a reduction of waste landfilled and incinerated by 14.81% and 2.98%, respectively, compared to the baseline. Recycling increases by 26.14%. This suggests that the waste hierarchy tax can be an effective tool for shifting waste output to higher levels in the hierarchy. The government's tax revenue appears to increase by 94.01% in relation to the baseline, while there is a moderate drop in the national GDP by 0.37%. In relation to previous studies, the difference between the baseline situation and the waste hierarchy tax can be understood through the ability of the tax to affect incentives and behavioural structures [51, 52].

Tietenberg [53] has illustrated how a policy reform aimed at reducing pollution needs to account for firm heterogeneity. Accordingly, this means that the tax should include different tax rates for different firms to be effective. This proposition is also confirmed by King et al. [54] who showed that environmental taxes should be targeted at specific goods/sectors to have an impact. Consequently, the same line of argument holds for the waste hierarchy tax. The waste hierarchy tax gives a clear signal of what type of waste treatment is considered unwanted through the differentiated tax rate.

Moving to Scenario B, the waste hierarchy tax is combined with a subsidy on recycling. While the scenario is similar to the pure waste hierarchy tax, there are some key differences in the simulation result that should be highlighted. Beginning with the impact of the tax subsidy on waste, the change in waste disposal and incineration from the baseline is larger than before with 34.23 and 8.61% decline, respectively. The level of recycling on the other hand rises by approximately 42.55%, which is considerably higher than in Scenario A. These results reflect those by Schwerhoff and Franks [40] who have demonstrated that subsidies can increase efficiency and pollution reduction in the sector that benefits from the subsidy. Therefore, the results suggest that a subsidy could be an effective method to shift waste towards recycling.

However, the results also highlight some downsides to the subsidy approach, resulting in a higher reduction of GDP with 0.89%. This result is in line with Xie and Saltzman [55] who showed that even if a subsidy has a positive impact on pollution, the effect on production and GDP is negative due to limited capital resources. Altogether, this implies that the costs of the subsidy, including less tax revenues, government spending and lower GDP, must be accounted for.

In Scenario C, following the suggestions of Böhringer and Rutherford [42], the impact of the waste hierarchy tax under a shift to more efficient technology is assessed. A shortcoming of this scenario is the fact that the theoretical framework relies on the assumption of exogenous

Table 3 CGE modelling main results (figures represent the percentage change from the baseline), adapted from [34]

Variable	Baseline	Scenario A (waste hierarchy)	Scenario B (recycling subsidy)	Scenario C (technology shift)
GDP	0.00	−0.37	−0.89	6.82
Transfers/government tax revenue	0.00	94.01	38.12	113.41
Waste for disposal	0.00	−14.81	−34.23	−7.63
Waste for incineration	0.00	−2.98	−8.61	10.06
Waste for recycling	0.00	26.14	42.55	40.73

technology. According to Böhringer and Rutherford [42], modelling technology as exogenous is a disadvantage when analysing technological change in relation to resource efficiency and waste. This is because the technology shift is not captured as an outcome of, for example, investment or research and development, which are important features for increasing resource efficiency [42]. Despite this, introducing a technological change scenario in the modelling of the waste hierarchy tax can still provide valuable insight to the analysis. With the combination of the waste hierarchy tax and the technology shift, the impact of the tax is noticeably different compared to the previous scenarios. The reduction of waste disposal at 7.63% from the baseline is smaller than in Scenario A and Scenario B. Moreover, in contrast to the previous results, both incineration and recycling levels rise with 10.06 and 40.73%, respectively.

Consequently, the technological improvement offsets the positive impact of the tax framework which is in line with the findings by Böhringer and Rutherford [42]. Following their reasoning, the results exemplify the so-called rebound effect that follows a technology shift. If the shift leads to lower production costs and prices, these changes can in turn lead to increases in demand and supply, which offsets the potential gains from technological change in resource efficiency and waste minimisation [56].

In summary, the results indicate that the waste hierarchy tax which accounts for the three bottom steps in the waste hierarchy has an impact on waste and would most likely induce further waste management improvements in Sweden. However, the results also highlight the fact that the impact of the tax is sensitive to its design and to the reactions in other sectors of the economy.

Based on the results of the CGE modelling of the waste hierarchy tax and insights from previous studies, a main macroeconomic concern is related to the question of the distributional effects on resources and capital that could follow the introduction of the tax: who wins and who loses due to the policy change? This question is important to consider for at least two reasons. Firstly, if the cost of the redistribution exceeds the gains, policymakers might have to abolish the policy to avoid economic and political damages [57]. Secondly, the group that loses because of the policy might stop its implementation if they have the power to do so [54]. In relation to the waste hierarchy tax, the losers would for example be those actors whose waste cannot be easily shifted towards higher steps in the hierarchy with lower tax rates. This implies that the tax might need to be combined with other policies to mitigate the potential negative distributional effects.

Lastly, the CGE modelling developed by Lokrantz [34] was subject to several limitations. To capture the effects of the waste hierarchy tax, several simplifications and assumptions were made, resulting to a "simpler" design of the model. Therefore, there is a potential for several possible future extensions. Future work could modify the model to include an international sector, with imports and exports of material resources. Additionally, it would be interesting to explore how to extend the model to capture other relevant features of the circular economy, for instance reuse of waste or extended product lifetimes.

Towards a Framework for Circular Economy Taxation

From the analysis of the different taxation interventions in the previous sections—targeting specific life-cycle stages of materials—it becomes apparent that the implementation of each one individually entails considerable challenges. Therefore, it is reasonable to bundle these interventions in a wider fiscal policy framework that counterbalances the observed weaknesses and creates stronger pull effects on purchasing decisions, enables behavioural change and facilitates a potential shift of the economy as a whole. The proposed Circular Economy Taxation Framework (Fig. 1) attempts to reconcile the diverse objectives of the different proposed taxes towards a common overarching aim, that of a circular economy transition.

The main outcomes of the potential implementation of a natural raw material tax indicate that (a) the level of the tax needs to be sufficiently high to have an impactful effect and (b) that the application needs to be horizontal to avoid materials substitution and to increase overall resource efficiency. Moreover, the implementation of the tax would result in competition risks across industrial sectors and national economies. The introduction of resource use taxes would contribute in establishing a competitive advantage of second hand goods (reuse) or services that substitute resource inputs, e.g. in the case of product-service systems [47]. Additionally, from a dynamic efficiency perspective, the tax could make R&D investments in such resource efficient business models (also known as circular business models) more competitive and in this way could influence innovation trajectories towards more resource-efficient patterns of production and consumption [10].

In the "Value Added Tax Reduction in Product Repair and Reuse" section, a critical barrier identified had to do with the difference in price between repairing existing products and buying a new product. When the price of new products increases, consumer preference towards repairing existing products—instead of buying new—also increases. Therefore, the introduction of a high material input tax coupled with a "generous" tax relief for repairs would incentivise consumers to choose repairs and prolonging the life of products. Moreover, the analysis of the effect of a waste hierarchy tax showed that waste generally would be redirected towards higher waste management options in the hierarchy, resulting in more recycling and potentially higher repair and reuse of EOL products. Although the effects of reuse were not captured by the CGE modelling by Lokrantz [34], it is a logical conclusion that waste holders would seek to avoid waste management fees and taxes by avoiding landfilling, incineration and recycling, and choosing to repair and reuse their existing equipment—to the extent possible (when ruling out the possibility of illegal disposal). If it is not possible to reuse the entirety of the EOL equipment, there is still a potential to salvage components and spare parts, thus reducing the level of material wastage [33]. In turn, salvaged parts could feed in repair activities, making them even more affordable to consumers by further sinking the cost of repairs. Salvaged components from EOL equipment could be sourced in lower prices than new spare parts (although this depends case by case). Moreover, in the case that spare parts are discontinued by the original manufacturer, the salvaged parts constitute a valuable source that enable the repair of a broken equipment that would have to be wasted otherwise.

Looking at all the elements of the proposed framework together, it is possible to discern a "sandwich" effect which pushes for more intense use of products over their lifetime and could more generally lead to product life extension, a prominent circular economy strategy [58]. The high price of using virgin raw materials from one side, and the high price of wasting raw materials on the other side, would ultimately lead consumers towards choosing more and more repair and reuse options which come with lowered costs (tax relief).

The Circular Economy Taxation Framework presented in this contribution can stand alone as an economic policy intervention, and it constitutes a holistic approach including all life-cycle stages of production and consumption, in a way that each of its constituent elements could not have addressed individually. However, its effectiveness towards achieving a wider multi-level and multi-stakeholder objective, such as the transition to a circular economy, would be limited if not complemented by an array of other policy instruments [59]. For instance, the taxation framework includes premises that affect market failures (externalities) and behavioural aspects (economic preferences) but fails to address sufficiently governance and institutional aspects. In the case of the natural raw material tax, issues concerning competitiveness between industries and national economies came up which could undermine the effectives of the tax if no counterbalance measures are taken. In the case of the repair tax relief, the empirical evidence showed a lack of public information that hampered its effectiveness. Moreover, the current production practices undermined the effectiveness of the tax since the difficulty of repairs and unavailability of spare parts were contributing factors to increased costs of repairs despite the tax relief.

The Circular Economy Taxation Framework could also be a useful add-on to existing CE policy frameworks, for steering consumer and firms preferences and internalising external costs. For instance, Milios [19] developed a comprehensive policy framework for material resource efficiency in the EU, which was lacking major fiscal components (Fig. 2). The Circular Economy Taxation Framework complements the Milios [19] framework, by adding the necessary economic elements in the policy mix, while the Circular Economy Taxation Framework benefits from the proposed policy instruments in several ways. The Ecodesign Directive (2009/125/EC) can regulate the durability, disassembly and recyclability of products as well as the availability of spare parts. By making products more easily repairable, the cost of repair would fall respectively and adding the tax relief on repairs, it would make it a more attractive and economical option. Moreover, a quality label for reused equipment would boost the confidence of consumers to trust the repair and remanufacturing processes, and coupled with the tax relief on repairs, it would increase their willingness to purchase reused goods. Finally, the proposed target for reuse (Fig. 2) could be facilitated by the waste hierarchy tax which does not assign any additional cost to the "reuse" option rendering it the de facto preferential option (not considering other associated costs of sourcing, repairs and distribution).

Finally, an efficient policy mix needs to consider the socioeconomic context of its implementation, including the potentially affected actors and interest groups, for instance firms that might lose market shares or investments as well as consumers [60]. This implies the need for certain approaches in the policy mix, which can redistribute revenues from the raised taxes back into the affected industries to provide support for implementing resource-efficient changes and innovation or develop skills training to create new job opportunities [10].

Conclusions and Future Research

The proposed CE fiscal policy framework constitutes an early attempt to reconcile economic considerations in the life cycle of products as a reasonable policy proposal that complements the overarching resource efficiency policy mix, as presented for instance in the EU strategy [61]. The framework includes a natural raw material tax, a repair/reuse tax relief and a waste hierarchy tax, which overall contextualises the first research question of this contribution.

To address the second research question, each of the constituent elements of the framework was individually scrutinised for their potential effectiveness and challenges of implementation, followed by an integrated discussion of the framework as a whole and in relation to other (non-economic) policy instruments.

At the material extraction stage, a tax imposed in a region would directly affect international trade of the targeted commodity. Therefore, counterbalance measures would be required to neutralise the negative environmental effects of potential shift in production location that a

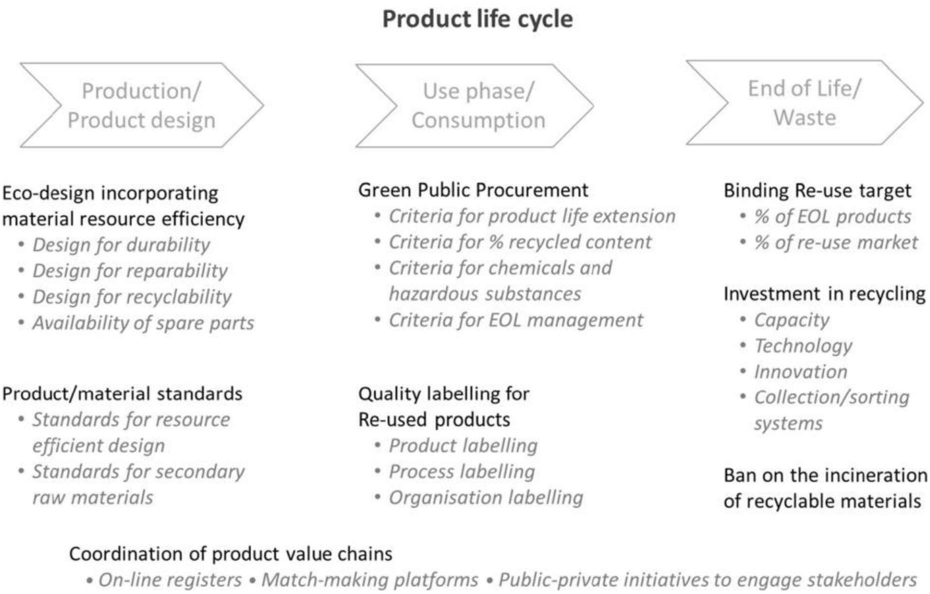

Fig. 2 Material resource efficiency policy framework with a life cycle perspective, developed by Milios [19]

resource tax would possibly lead to. The possibility of material substitution constitutes a critical factor for the effectiveness of resource input and consumption taxes and forms a major drawback if designed to address a single material resource. Taxing a single material might result in substitution rather than overall resource efficiency. Further, the potential substitutes of the taxed material may have other unpredictable environmental disadvantages, such as higher energy intensity or lower recyclability.

In the case of the Swedish VAT reduction in repair services, implemented since 2017, the results showed that it has not made a significant impact. However, some of the interviewed companies have observed an increase in the number of repairs. Despite this, the majority of the interviewees could not link the increase in repair frequency to the respective tax change. This implies that complementary policies and/or initiatives are needed. Suggestions to increase the number of repairs include better communication to the public in order to increase the awareness of the tax.

The CGE modelling results of the waste hierarchy tax showed a generally positive impact on waste generation and recycling, with minor negative effects on GDP growth and productivity. From the different scenarios analysed, the application of the waste hierarchy tax coupled with government subsidies to the recycling sector showed the highest potential for implementation.

Taking into account the specificities of each of the analysed economic interventions, it becomes apparent that the full potential of the individual instruments can only be realised when combined within a comprehensive policy framework including other economic, administrative and informative policy instruments. The fast evolving literature on the governance aspects of CE and the enabling policy approaches would benefit from the findings of this research by integrating some of the proposals and generating further research avenues or road mapping exercises for transition.

Further research is required both at the individual instrument and at the framework level. Each of the tax proposals needs a more detailed examination for its specificities of implementation, following the results of this study. Also, further research is needed for integrating the individual instruments in a consistent and comprehensive way to strengthen its overall impact on the policy mix. The integrative approach could make use of quantitative economic modelling to produce actionable results. However, the sheer complexity of the economic interactions within the proposed framework and across economic sectors might prove particularly challenging. Application within a national economy, as in the case of Sweden, might be a first step. Application of the framework to a wider context, e.g. the EU, could be of high significance under the new CE strategy and the "Green Deal" for Europe.

Code Availability N/A

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Compliance with Ethical Standards

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Interactions of governmental policies and business models for a circular economy: A systematic literature review

Raphael Wasserbaur, Tomohiko Sakao and Leonidas Milios

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A systematic literature review on the interactions of governmental policies and business models for a circular economy

Raphael Wasserbaur[1], Tomohiko Sakao[*,1], Leonidas Milios[2]

[1] Division of Environmental Technology and Management, Department of Management and Engineering, Linköping University, 58183 Linköping, Sweden

[2] International Institute for Industrial Environmental Economics, Lund University, 22350 Lund, Sweden

* Corresponding author: tomohiko.sakao@liu.se; Tel.: +46 73 620 9472.
Address: Department of Management and Engineering, Linköpings Universitet, 58183 Linköping, Sweden

Abstract

Governmental policies and business models are considered key elements for a transition to a circular economy. In current literature, there is a lack of understanding on how these two elements interact and how this understanding is used to accelerate the realisation of a circular economy. We shed light on this issue by conducting a systematic review of the literature in combination with a literature synthesis that looked in particular at interactions between governmental policies and business models not limited to a circular economy. We systematised the findings and then applied them to a circular economy context. The results show that there is a multitude of possible interactions between governmental policies and business models. The most commonly studied interaction is between command-and-control regulations and the value proposition element of business models. Soft policy measures like information- or communication-based policies or support mechanisms are less studied. Other findings suggest that there are certain types of dynamics which are useful to understand for policymakers and business model designers alike. A few examples of the synthesised insights are i) entrepreneurs may optimise their circular business models to exploit the policy framework, ii) technologies may lead to circular business model innovation forcing policymakers to adapt, and iii) policymakers may pay special attention to the needs of circular business models and support their competitiveness.

Keywords: business model; interplay; governmental policy; circular economy; systems perspective.

1 Introduction

Circular Economy (CE) receives growing attention in academia and societies at large. CE focuses on maximising the value and utility of resources and energy within production systems, based on the premise that natural resources are scarce, and that End-of-Life (EoL) products may retain some value (Ghisellini, Cialani et al. 2016). Having its roots in various scientific disciplines such as industrial ecology and environmental economics (Ghisellini, Cialani et al. 2016, Bruel, Kronenberg et al. 2019), CE is not solidly defined in literature, but follows a few general principles that appear consistently in multiple CE definitions. Kirchherr, Reike et al. (2017) reviewed 114 definitions of CE and presented the most common characteristics of CE as a concept, which is described as an economic system that replaces the concept of EoL with premises of total material use reduction; re-use of products by extension of product life through repair, refurbishment and remanufacturing; and finally recycling and recovering materials from production and consumption. CE is operationalised at multiple levels, including a micro level (products, services, companies, and customers), a meso level (eco-industrial parks and economic sectors), and a macro level (region, nation and beyond). The ultimate goal of CE is to promote sustainable production-consumption systems, through maintaining environmental quality, ensuring economic prosperity and socio-economic equity.

For CE to live up to its sustainability expectations, it needs to address a wide spectrum of aspects pertaining to production-consumption systems. There is a variety of research streams investigating CE (e.g. Tukker

2015) from different angles. The insights obtained thus far concern knowledge with, e.g., design of product/service (Tukker 2015), user behaviour (Camacho-Otero, Boks et al. 2019), business models (BMs) (Bocken, de Pauw et al. 2016) and governmental policies (GPs) (Milios 2018). For the transformative aspects of CE to take place, Planing (2015) suggested that a set of preconditions must be in place and interact with each other. Building upon Planing (2015), a systemic transition to a CE includes four fundamental building blocks:

1) materials and product design: wide adoption of eco-design principles in product design (Mont 2008) and careful material selection practices (Bakker, Wang et al. 2014), coupled with a purposeful product life extension mind-set that keeps products, components and materials at their highest possible utility and value (Russell 2018) in contrast to planned obsolescence principles (Maitre-Ekern and Dalhammar 2016).

2) Circular Business Models (CBMs): business offerings based on the provision of capturing residual value in products, encouraging take-back systems and circular product design (Nußholz 2017). This includes also business offerings based on function provision, e.g., leasing, sharing, pay-per-use and pay-per-result (Tukker 2015).

3) Reverse supply networks: integrating reverse logistics into conventional supply chains enabling companies to optimise their operations by making profit through the recovery of used products (Masi, Day et al. 2017).

4) Enabling conditions: there is a variety of enablers that may support a CE transition, broadly encompassing enabling policies, but can include regulations, financing, the support of markets for secondary materials or products (Milios 2018, Saidani, Yannou et al. 2018), raising consumer awareness (Michaud and Llerena 2011) and making effective use of digital technologies (Antikainen, Uusitalo et al. 2018).

In research and practice of CE, the systems perspective has been identified to be critical (Webster 2013, Pieroni, McAloone et al. 2019), where interactions between system elements play a key role. The building blocks of the CE need to interact with each other to enable a systemic shift towards more sustainable circular production-consumption systems (Planing 2015). Various literature sources evidence research efforts to analyse and understand the interactions between the different building blocks of the CE and offer a partial understanding of the systems' components and their interactions. For instance, there have been a few attempts to synthesise literature insights between product design and policy interactions in the case of the EU eco-design regulation (Bundgaard, Mosgaard et al. 2017), and the setting of mandatory product standards (Tecchio, McAlister et al. 2017). Similarly, scholarly literature studied the interactions between reverse supply networks and BMs (Bressanelli, Perona et al. 2018), and policies (Govindan and Hasanagic 2018). A systems dynamics approach was used by Franco (2019) to synthesise literature insights of product design and BMs. However, what is currently missing is a systematic approach in combining insights of GPs and BMs; both are key integral components of the CE system (Tukker 2004, Planing 2015).

Several cases have been reported where the current regulatory framework failed to accommodate CE ventures that seemed economically and environmentally sound (Salmi, Hukkinen et al. 2012). Policies related to CE are being drafted and implemented across the world with the objective to transform societies towards CE (Bocken, Olivetti et al. 2017, McDowall, Geng et al. 2017). Policy initiatives include but are not limited to: a) policies influencing product design (Maitre-Ekern and Dalhammar 2016), b) policies pertaining to manufacturing/provision of products and services, c) policies pertaining to consumption (European Parliament 2017), d) policies that address waste/EoL resource management (Dace, Bazbauers et al. 2014), and, e) policies supporting market development of circularly managed resources (McDowall, Geng et al. 2017).

Additionally, there is a substantial amount of literature analysing interplays between BMs and GPs in specific cases, e.g. renewable energy (Overholm 2015), banking (Jovanovic, Arnold et al. 2017) or e-mobility (Christensen, Wells et al. 2012). The reported insights are often sector and topic specific, dependent on concrete cases, and described in a language specific to the respective academic domain. There is virtually no work that was performed for CE concerning this issue, and no work synthesised the findings of the different sectors and disciplines, either.

To fill this gap, the research objectives for this paper are to use a common framework to select, evaluate and categorise the literature pertaining to interactions between GPs and BMs, in different sectors in general (i.e., not limited to the CE realm), analyse their relevance to CE, and point out future research avenues in the CE context. The intention of the authors does not lie in creating a new theory to performing literature analysis within this article. This research is expected to contribute to the understanding of CE as a system, which includes the GP and BM elements as well as their relations. The theoretical contribution lies in showing how the high-level system elements are interlinked with reference to multiple examples that occurred in real life in various sectors. Specifically, the research will identify potential policy interventions that are enabling a shift towards CBM configurations as well as whether the CBMs are affected in their design and how they could respond proactively or reactively to GP pressures/effects. The insights will help better decision-making in a transition towards CE, both at business model design and public policy design.

The method chosen was a mixed approach consisting of a systematic literature review and a synthesis, which is a good fit for conceptualising the reported insights and for creating a foundation for advancing knowledge. In order to put this work into perspective, basic CE principles and frameworks are visited as well. Relevant literature included articles containing both BMs and GPs as parts of their research focus.

The remainder of the paper consists of the following. Section 2 presents basic principles of CE and strategies that can materialise CE configurations, as a background of analysis for the literature review results. Section 3 provides detailed information on the procedure adopted for the literature review in a transparent and reproducible manner. Section 4 presents the results of the systematic literature review followed by Section 5, which synthesises and discusses the findings in the CE context. Finally, Section 6 concludes the paper and provides the authors' suggestions for future research avenues.

2 Basic principles and operationalisation frameworks of the Circular Economy

Broadly, three core principles are derived from the various definitions that govern the CE cycles (EMF 2015a, Ghisellini, Cialani et al. 2016, Kirchherr, Reike et al. 2017, Reike, Vermeulen et al. 2018): a) conservation of natural capital, by creating an equilibrium of use between renewable and non-renewable resources; b) extended lifespan of resources through both biological and technical cycles, i.e. enhancing the circularity of resources and energy; and c) reduction of the negative effects of production systems. To operationalise these principles at micro, meso, and macro levels for the purpose of sustainable development, several strategies have been proposed in literature, establishing comprehensive frameworks.

Each of the CE frameworks has its particular focus. Potting, Hanemaaijer et al. (2018) propose the ten step strategies priority framework, introducing the 10R principle (refuse, rethink, reduce, re-use, repair, refurbish, remanufacture, repurpose, recycle, and recover) of priority action towards a CE. The framework further differentiates between the lifecycle stages, from the conceptualisation and design of a product to extending its useful life, and ultimately to the useful recovery of its material content or energy. In a similar conceptual framework, Reike, Vermeulen et al. (2018) identify the same CE strategies, only differentiating by adding a final recovery strategy, that of 'Re-mine', integrating concepts such as landfill mining and urban mining to the CE framework. Moraga, Huysveld et al. (2019) present a simplified version of a five-strategy approach to CE: 1) preserve the function of products or services provided by CBMs such as sharing platforms or product/service systems (use- and result-oriented); 2) preserve the product itself through lifetime increase with strategies such as durability, reuse, restore, refurbish, and remanufacture; 3) preserve the product's components through reuse, recovery and repurposing of parts; 4) preserve the materials through recycling and downcycling; and 5) preserve the embodied energy through energy recovery at incineration facilities and landfills.

Other important aspects that go hand in hand with the proposed strategies for CE include the need for supply chain integration and coordination (Bressanelli, Perona et al. 2018, Milios 2018), as well as transparency and information exchanges concerning the quality of materials in products (Iacovidou, Velenturf et al. 2019). Winans, Kendall et al. (2017) identify exchange of information as one of the major constraints on the effectiveness of CE strategies. Finally, another approach, mostly targeting business actors outside academia, is the ReSOLVE framework (EMF 2015b). It introduces technological aspects such as Industry 4.0 and digitalisation/virtualisation of products and services (EMF 2015b). This framework is highly useful in CE practice and therefore will be employed to indicate the implications of this review to practitioners later in this paper (Section 3.4).

3 Research method

3.1 Overview

In order to reach the goal of this paper, a multi-step method shown in Figure 1 was used. This method is based on seminal works on systematic literature review (e.g., Tranfield et al. 2003). Steps 1 to 3 were the identification and screening of relevant papers, which represent some results in quantity (Section 3.2). Steps 4 and 5 focussed on interactions between BMs and GPs, requiring an elaborate in-depth analysis of the core papers (Section 3.3 and 3.4, respectively). In Step 6, in order to show the relevance of this work to CE, the identified interactions were mapped onto the ReSOLVE framework (Section 3.5).

This review work partly builds upon scoping studies (Arksey et al. 2005) and has a clear scope on the interaction of GPs and BMs, as earlier interaction with businesses (e.g., Sakao, Wasserbaur et al. 2019) informs the importance of interplays between GPs and BMs in the CE practice. It maintains the positive features of scoping studies such as knowledge dissemination, which is indicated especially by Step 6.

A challenge in systematic literature review in multi-disciplinary research, for instance, in defining constructs, is noted. Also, there is a tension in academia between the statistical benefits of using quantifiable aspects from the analysed pool of literature and the rich, quality analysis of more selected studies. This research method was operationalised with the major intention of making impacts in the real-world practice (following the idea of trans-disciplinary research, e.g., Sakao et al. (2018)) for presenting results in an accessible and usable form (Sandelowski, Docherty and Emden, 1971, p. 365): on the one hand, the scientific quality was maintained; for instance, the compliance with the general features of systematic literature review such as unbiased search and transparent process (e.g., Tranfield et al. 2003). On the other hand, this review work synthesises the underlying literature (Tranfield et al. 2003) and intends to provide transferable insights from different sectors in the form of "what could be useful for business leaders and policy makers in the CE context".

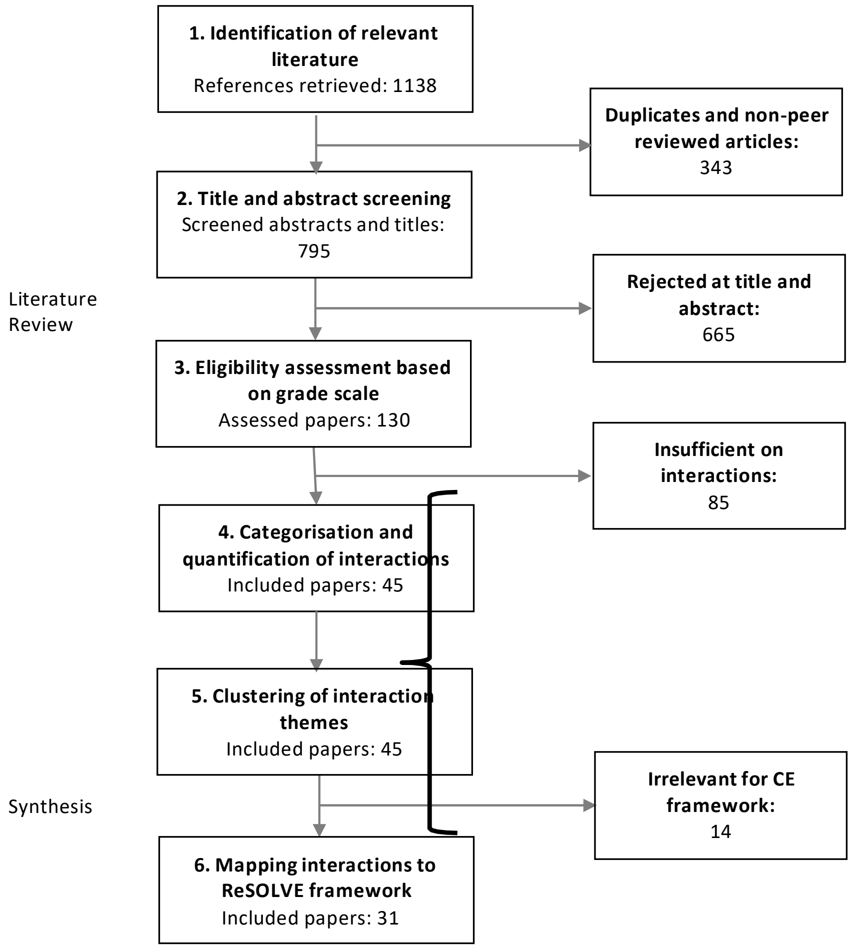

Figure 1. The process for the systematic literature review adopted in this research

3.2 Identification and selection of relevant papers (Steps 1 to 3)

Step 1 identified potential papers for further analyses. The search string's formulation was "business model" AND ("regulat" OR "policy"). The time period was not set. Only English language, peer-reviewed, academic journal articles were sought. The Web of Science Core Collection was chosen due to the journals' high impact factors. In Step 2 of the review process, the articles were screened to remove duplicates and to exclude papers with unfit title and/or abstract. In Step 3, the eligibility and relevance of the papers for further in-depth analyses was assessed, which involved full-text analysis. In order to decrease the subjectivity of the eligibility assessment, a relevance scale was introduced. The scale had the following grades:

1. **Irrelevant:** either GPs, BMs or both were not addressed to a sufficient degree. E.g. unclear usage of the BM concept or a vague description of policy impacts.
2. **Low relevance:** both GPs and BMs were part of the analysis, but the links between them were weakly explained or not clear.
3. **Medium relevance:** both GPs and BMs were addressed, and interactions could be discerned by the reader.
4. **High relevance:** both GPs and BMs were addressed, and interactions were described.

5. **Very high relevance:** GPs and BMs were addressed directly or indirectly, and links between them were clearly described. Interactions were clearly described in the article.

Once the entire sample was assessed for its eligibility, the papers with high and very high relevance were used for the remaining method steps.

3.3 Interactions between government policies and business models (Steps 4 and 5)

At the core of this review are the interactions between GPs and BMs. These interactions were analysed quantitatively and qualitatively. For the quantitative analysis in Step 4, a framework consisting of policy categories (see also Taylor, Pollard et al. (2012)) and BM aspects was created (see Table 1). The categories of the GPs were:

- **Legislation/regulation:** mandatory obligations or restrictions imposed by a governmental body upon an individual or an organisation.
- **Economic/fiscal:** policies changing the incentive structure of an individual or an organisation through taxes, tariffs, subsidies, tradable rights, etc.
- **Information- or communication-based:** information provision influencing behaviour of individuals or organisations.
- **Support mechanisms and capacity building:** policies aiming for the generation of knowledge and research, conducting demonstration projects, the dissemination of knowledge, and the facilitation and building of networks and cooperative problem solving.

GPs may be implemented on several governmental levels, from the municipality level to the supranational level (e.g. EU).

The BM categories were similar to those used by Osterwalder, Pigneur et al. (2005). Osterwalder and colleagues divide a BM into nine components: value proposition, customer segments, customer relationships, key resources, key activities, distribution channels, key partners, cost structure, and revenue model. BMs will be further discussed in Section 4.1.2.

GP-BM-interactions are organised in a framework consisting of the nine BM categories and four GP categories. The framework is depicted in a matrix (Table 1), which made it possible for the researchers to categorise interactions between GPs and BMs. Examples of interactions may be effects of transparency regulations on cost structures in the banking sector (Jovanovic, Arnold et al. 2017) or revenue effects of feed-in-tariffs to foster renewable energy-related BMs (Overholm 2015). The interactions were identified and assessed; finally, each article was assigned to an appropriate cell in the framework as shown in Table 1 (see also Appendix).

In addition to mapping the interactions quantitatively, a more qualitative synthesis of the results was conducted in Step 5. The authors searched for characteristics and reoccurring patterns in the reviewed articles resulting in a clustering of themes. These analyses were guided by the intention to understand how GPs influence BMs and vice versa. The discovered insights are presented in Section 4.2.

3.4 Contextualisation for the circular economy (Step 6)

This paper adopts a combined approach, systematic literature review and synthesis as the research method (as depicted by Figure 1). The literature covered includes articles outside the context of CE; yet the insights on the interplays between BMs and policies in general are potentially applicable to those in the CE context. In fact, many articles were very relevant in the CE domain, for example, those related to renewable energies. In order to contextualise the findings around the interactions between BMs and GPs, the most relevant papers were mapped onto the previously mentioned ReSOLVE framework.

The ReSOLVE framework was deemed a fitting approach in the contextualisation of GP-BM interactions within a CE perspective due to its business-oriented nature which is rather applicable than purely theoretical.

The three principles of the CE, as outlined in Section 2, are translated into six business actions in the ReSOLVE framework: regenerate, share, optimise, loop, virtualise, and exchange (EMF 2015b). *Regenerate* refers to regenerating and restoring natural capital by prioritising the restoration and resilience of the ecosystem. *Share* refers to maximising asset utilization, pooling the use of assets and reusing/adapting assets. *Optimise* refers to system performance and includes prolonging an asset's life, decreasing use of resources and implementing reverse logistics to increase the overall resource efficiency of the system. *Loop* refers to keeping products and materials in cycles, prioritizing higher value loops such as remanufacturing and refurbishing of products and components, followed by the recycling of materials. *Virtualize* entails substituting resource use with virtual use, replacing physical products and services with virtual services, replacing physical with virtual locations and delivering services remotely. *Exchange* is about using flexible design and use, leasing and performance-based models to deliver same function with reduced material inputs and/or environmental impacts. This can be done by using alternative material inputs, providing service-centric models, and using advanced technology where appropriate.

To contextualise the results of the literature review, the identified interactions of BMs and GPs are categorised into these six CE action areas and their potential in affecting changes is discussed. Section 5 presents the results of this mapping exercise.

4 Results

4.1 Quantification of interactions (Step 4)

4.1.1 Relevance and origins of publications

Following the description of Step 1, the query was conducted in January 2019 and initially 1,138 publications were found. Duplicates and non-peer reviewed articles were removed.

In Step2, 795 articles were screened by title and abstract. In the third step, the remaining 130 articles were assessed by their full text. The irregular usage of the terminologies throughout the articles required additional efforts for evaluating their relevance. The relevance scale (see Section 3.2) was found to be useful for assessing the eligibility of each article. Out of these 130 papers, 70 were irrelevant and not eligible for further analyses, 14 ones had medium relevance and one had low relevance.

For Step 4, out of the remaining 60 articles 45 were found to be highly relevant or very highly relevant. These 45 relevant articles were analysed further.

There is an increase in the number of relevant articles published in recent years, from 1 article found in the year 2009 to 16 articles found in 2018, showing the increased relevance of the interactions between GPs and BMs. The sample records stem from a variety of scientific journals, which is unsurprising considering the thematic distance between the two core concepts of GPs and BMs.

4.1.2 Applied BM frameworks

Osterwalder, Pigneur et al. (2005) operationalised the BM concept with the *BM canvas*. It is the most widely used framework for analysing the BM concept. In the following, conceptualisations of BMs suggested by other authors are referred to as well. Indicating its prominence in literature, the BM canvas was customised for a multitude of sustainability-oriented ventures throughout the reviewed articles.

The majority of authors used the BM concept without clearly defining it. At times BM was used synonomysly for revenue model (Karneyeva and Wustenhagen 2017) or key activities (Angeli 2014). In other places, BM referred to the value delivery, was used to distinguish between a product- or a service-based offering (Finne, Brax et al. 2013), or was used to describe the ownership-structure of the business transactions. Several authors used the BM term to refer to a kind of general business practice of the industry. From the group of papers which actually defined their understanding of the BM concept, most authors refer to the framework of Osterwalder, Pigneur et al. (2005). Along these lines, Engelken, Romer et al. (2016) found that the inconsistent use of the BM concept is hindering comparability of research studies and is suboptimal for scientific progress.

Within the reviewed articles four other BM frameworks were found besides the work of Osterwalder and Pigneur. The second most important BM reference used was Zott and Amit (2010). Zott and Amit define BMs as depicting *'the content, structure, and governance of transactions designed to create value through the exploitation of business opportunities'* (Zott and Amit 2010). A third BM framework can be found in Baden-Fuller and Haefliger (2013), who developed a typology of four dimensions to identify a BM: customer identification, customer engagement, value delivery and monetisation. A fourth framework is proposed by Walravens (2015). Walravens focussed on the control over the value network and how much value is generated by the network. Their BM framework consists of four aspects, the construction of the value network, the functional architecture including the role of technology in the value creation, the financial model describing how revenue is distributed in the network, and the value proposition. They did not focus upon the individual firm but on the entire network of firms.

4.1.3 The interaction matrix

In order to quantify the interactions found in the reviewed articles, the above-mentioned (see Section 3) categorisation for GPs and BMs was used. Table 1 organises the BM components in rows and the policy categories in columns. The interactions are unevenly distributed across the categories. The policy category legislation/regulation was observed to be most occurring in the reviewed articles. Legislation/regulation had most interactions with value proposition followed by cost structure and revenue model. Economic/fiscal policies also appeared fairly frequently in combination with value proposition, cost structure as well as revenue model. Interactions with information or communication-based policies were infrequently highlighted throughout the reviewed

Table 1. The interaction matrix presenting the frequency of interactions between GPs and BM aspects identified in the reviewed articles.

BM aspect \ GP category		Legislation/Regulation/ command-and-control (L)	Economic and fiscal (E)	Information-based and communication-based (I)	Support mechanisms and capacity building (S)
1.	**Value proposition**	22	9	3	2
2.	**Customer segment**	11	4	1	1
3.	**Customer relationships**	6	0	0	2
4.	**Key resources**	9	0	0	2
5.	**Key activities**	15	4	0	3
6.	**Distribution Channels**	7	0	0	1
7.	**Key partners**	16	1	1	5
8.	**Cost structure**	16	11	0	4
9.	**Revenue model**	15	11	0	3

Note: See also Appendix; Table A1 including the paper references corresponding to the cell values.

articles. It was found that the largest group of papers investigated how regulatory frameworks affected BMs or how BMs were changed in order to adapt to new regulatory environments (see also Section 4.2.1). One interpretation of the uneven distribution of interactions might be that some BM components are harder to investigate than others; e.g., both the revenue model and the cost structure can be, to a fair degree, deduced from public materials. Second, in a free-market economy, the ways to influence a company's BM as a policymaker are limited. Financial policy incentives or disincentives are relatively common instruments to influence company responses. The identified interactions were unevenly distributed across the policy categories and gravitated towards legislation/regulation. This may reflect the permanent adaptation processes between GPs and BMs.

Throughout the review, certain BM components were more commonly affected by GPs. More literature was found that reported on the interrelations with 1) value proposition (e.g. governments' communication for promoting new technologies on smart grid technologies influenced on values perceived by citizens (Pereira, Specht et al. 2018)), 5) key activities (e.g. legislations for assessing carbon emission standards for building projects (Zhao, Chang et al. 2018)), 7) key partners (e.g. municipalities for collecting used products (Whalen, Milios et al. 2018)), 8) cost structure (e.g. feed-in tariffs for deploying photovoltaics (PVs) (Karneyeva and Wustenhagen 2017)) and 9) revenue model (e.g. PVs investors were exposed to revenue risk by changing GPs (Karneyeva and Wustenhagen 2017)) among the nine (9) elements adopted in this article (see Table 1). On the other hand, 3) customer relationships and 6) distribution channels were reported by substantially less literature to have interrelations with GPs. This provided different possibilities of interpretation, but value proposition, key activities, key partners, cost structure, and revenue model may be more suitable for GPs to be affected directly.

4.2 Clustering of interaction themes

This section is subdivided by the larger themes that emerged during the in-depth analysis. As the subsections do not correspond to the subject areas of the papers, papers rich in interactions may appear in multiple subsections. This way of organisation is deemed useful as documentation of the review results before moving to implications for CE (in Section 5).

4.2.1 Business models adapt to policy frameworks

Within the reviewed articles, several case studies described how a BM emerged in a given framework of GPs or how a BM was adapted to changes of such a framework. For instance, Angeli (2014) described the case of Indian pharmaceutical companies that after a change in an international trade agreement shifted from reverse engineering-based BMs to R&D-based BMs. From a different geographical region, Berti and Casprini (2018) described how an airport BM was modified due to a new regulation in the Italian airport industry.

Burger and Luke (2017) underlined the deep embeddedness of BMs in the regulatory framework of the distributed energy sector, policies "mould" BMs through given incentives. In this specific sector, BMs were influenced seemingly more by policies than by technologies. On the other hand, de Oliveira, Mendes et al. (2018) showed how specific BM choices of a juice machine producer in Brazil were affected by tax legislation, i.e., varying tax rates on renting, services or product sales (de Oliveira, Mendes et al. 2018).

In relation to transition of energy sources, several interesting cases were reported. Engelken, Romer et al. (2016) outlined the importance of appropriate policy drivers for renewable energy BMs; they recommend policymakers to create stable and reliable planning conditions for companies, governments should provide education opportunities in regions where needed, and developing countries should copy proven legal frameworks from countries with functioning frameworks. The authors also stress the need to fight corruption in developing countries. Karneyeva and Wustenhagen (2017) compared existing regulatory frameworks for BMs in three PV markets in Germany, Italy and Switzerland. They found that even in post-grid price parity situations, feed-in tariffs are very important to investors for limiting policy as well as revenue risks. Similarly, Christensen, Wells et al. (2012) analysed the BM of an electric vehicle system in Denmark and documented its high dependance on the Danish pro-electric vehicle policy framework.

Furthermore, policymakers might consider the inabilities of small actors that have limited resources compared to larger ones. In a renewable energy context diversity of BMs is decreasing as smaller operations cannot keep up with policy changes or with the regulations compliance costs that are too high, e.g., compared to established energy corporations small collectively-owned solar farms lack the necessary resources (e.g., trading capabilities) in a post feed-in tariffs environment and are depending on policy stability and policy support in order to be able to compete and attract investments (Karneyeva and Wustenhagen 2017). Third-part ownership (TPO) BMs are reaching a broader customer group as consumers do not face the high upfront costs of solar PV installations. Policymakers can facilitate TPOs through a preferable tax code, policy stability, a reliable status regarding the legality of TPO BMs as well and manageable administrative costs, e.g. standardised contracts (Overholm 2015, Strupeit and Palm 2016).

New BMs in this sector are facilitated by liberalisations of the energy markets including the unbundling of energy systems, and a diversification from large centralised public utilities to many de-centralised and smaller private actors. For example, a liberal net metering regulation was key for the uptake and the legality of solar PV BMs in the Netherlands (Huijben and Verbong 2013).

In the Chinese renewable energy sector, regulatory hurdles exist for easy access of buildings to participate in energy aggregation markets, this goes along with a lack of incentives to implement energy control systems that make the energy demand of buildings more flexible (Ma, Billanes et al. 2017).

In the USA customers exhibit lower saving rates and higher frequency of changing residence. For value offerings in the USA are therefore immediate savings on the electricity bill are more interesting; regulations allowing for net metering as well as contracts that connect payments to house ownership are other crucial elements. The situation in Japan and Germany is different - on average saving rates are higher, and people move less frequently and customers more often have a long-term perspective for investments, which results in different loan conditions and necessary subsidies for banks (Huijben, Verbong et al. 2016, Strupeit and Palm 2016).

4.2.2 Co-evolution of governmental policies and business models

Within the reviewed articles, a group of papers applied a dynamic point of view. They showed that over time GPs and BMs change, co-evolve, and affect each other.

Dewitte, Billows et al. (2018) reported about three “regulation-adaptation loops”, that explained the peculiarities of the French retail market. Policymakers in France created a regulatory framework that despite opposing political interests lead to a higher concentration and a higher number of hypermarkets in the retail market than any other European country. The authors explained this development in which on multiple occasions, specific regulations led to BM adaptations that counteracted the policymakers’ original intentions. These types of considerations draw attention to the fact that these interactions are part of a dynamic complex system that can lead to unintended consequences. The authors state *“understanding the real impact of regulations on the business strategies and the BMs adopted by mass retailers requires a longitudinal approach”* (Dewitte et al. 2018, p.1006).

Dobusch and Schussler (2014) reported how the ongoing discourse around copyright reform as well as technological advances in the music industry, affected BMs over time and how incumbent players tried to protect their sales-based BMs against lax copyrights legislations as grown industries have built their BMs around copyright regulations. The opportunities given by digitalisation and the internet posed existential threats for incumbents and caused regulatory struggles that were promoted through a shift in society’s view on copyright, disruptive technologies, and BM innovations.

Finne, Brax et al. (2013) presented the case of Xerox, a company that due to antitrust issues was forced to de-servitize its BM. Hannon, Foxon et al. (2015) researched how governments can support energy service companies' BMs most efficiently and Plepys, Heiskanen et al. (2015) analysed how the changing European regulatory framework supported the transition from product-based to service-based BMs.

PV-based BMs were researched in multiple articles. Herbes et al. (2017) investigated the case of German renewable energy cooperatives whose BMs were endangered due to changes in the solar feed-in tariff system, as energy cooperatives find it difficult to cope with a change in the incentive structures. The authors highlighted the need for a closer collaboration between the cooperatives and policymakers. Energy cooperatives needed expertise and training in tendering systems, open market bidding systems etc. Huijben and Verbong (2013) presented three BMs that emerged around the Dutch regulation on net metering. Net metering is the balancing of electricity fed into and taken from the grid via the energy bill. The authors explained that in a regulatory framework with relatively low levels of subsidies, BM innovation was the crucial factor for the PV uptake in the Netherlands, and Huijben, Verbong et al. (2016) compared Dutch and Belgian regulatory environments for BMs in the PV industry. Interestingly, GPs designed to support PV, were found to enable as well as limit BM innovations in the two countries.

Entrepreneurs or BM developers can utilise the space between BMs and regulatory frameworks. New ideas can overcome or diminish existing regulatory barriers. Company decision-makers may be educated in how to exploit the regulatory framework their companies are operating in. Huijben, Verbong et al. (2016) recommend entrepreneurs should assess their BMs, identify where they can use the GPs to their advantage and adapt their BMs to optimally fit and exploit the regulatory framework. Airbnb, Uber etc. have shown how successful the conscious exploitation of legal loopholes can be (Biber, Light et al. 2017).

Another option is to, individually or collectively, alter the regulatory framework in their favour through lobbying, legal or other efforts (Huijben, Verbong et al. 2016). Especially in industries where CBMs need to compete against established linear BMs.

4.2.3 Regulatory support for BMs

Policy support can be an important aspect for BMs. Typically, subsidies or tax reliefs, but also support mechanisms, or information campaigns help companies, to be economically viable in the context of changing conditions as is the case in a transition towards CE. Creating protected niches provides valuable support for companies with innovative BMs that need to reach a certain level of maturity first in order to be able to compete in a later stage in the open market (Huijben, Verbong et al. 2016). For example, Jovanovic, Arnold et al. (2017), were clear about the strong impact of regulatory changes on cost structure, revenue model and value creation of cooperative banks. Other banking BM-related topics were effects of heightened liquidity regulations on banks' BMs (Paulet 2018) or the robustness of ethical banking in the economic crisis (Paulet, Parnaudeau et al. 2015).

However, not every BM requires special governmental policy support: many BMs function commercially, without specific governmental support.

Karneyeva and Wustenhagen (2017) compared the regulatory frameworks for BMs in three PV markets in Germany, Italy and Switzerland. They found that without risk-reducing policy support, grid parity of PVs did not suffice to keep private investments up. The authors argued for upholding certain levels of policy support. Muller and Welpe (2018) compare the regulatory frameworks of Australian and German multi-household electricity storage systems. Low grid fees and flexible access to distribution networks facilitated community level storage systems. These comparisons provide accounts for different BMs building upon different policies.

Long-term stability of GPs is critical in some businesses: e.g., local energy management in the energy transition (Facchinetti, Eid et al. 2016), development of solar electricity markets (Overholm 2015, Karneyeva and Wustenhagen 2017) and biogas produced from organic wastes (Karlsson, Halila et al. 2017).

BMs requiring large investments and therefore, long payback times will benefit from long-term stability of governmental support.

4.2.4 Public-sector BMs

Within the reviewed sample, six papers featured a close connection of a governmental or public sector organisation with the BM concept. The topics were either related to BMs of public sector organisations or public-private partnerships, in sectors like large technical systems (Kanda, Sakao et al. 2016) and urban transportation (Zhang, Zhang et al. 2015). The authors addressed diverse topics, such as environmental technologies (Kanda, Sakao et al. 2016), city transportation (Walravens 2015, Zhang, Zhang et al. 2015, Li, Zhan et al. 2016), public research organisations (Schillo and Kinder 2017) or public financing of sustainable companies (Benijts 2014).

The authors of three of the papers (Walravens 2015, Kanda, Sakao et al. 2016, Schillo and Kinder 2017) tried to advance existing BM frameworks by including public actor-specific aspects. Kanda, Sakao et al. (2016) showed how important public-private partnerships can be for the diffusion of large-scale environmental technologies. For large technical systems, such as waste treatment plants, municipalities typically play an important role either as suppliers or as customers. While underlining the socio-technical and trans-organisational character of large technical systems, Kanda et al. synthesised BM literature and defined six so-called “business concept components”: market, finance, resources, activities, partnership and ownership and responsibility, which can be interpreted as a BM framework. The authors claimed that the business concept offers opportunities for system-wide environmental improvements in contrast to organisational-level improvements that might occur through a normal BM approach. Furthermore, this new BM framework for large technical system improves planning of diffusion of environmental technologies with regards to regulations, public private partnerships, and legitimacy.

Walravens (2015) departs from a BM framework revolving around control of the value network and value creation and extends it with the concepts, “governance” and “public value” to adapt it to BMs of services offered by cities. Schillo and Kinder (2017) focused on BMs for public research organisations. The authors call the BM framework “impact model”. The impact model helps to show various ways of how external actors interact with public sector organisations in the field of technological innovations. The authors presented a case of a Canadian public sector research company and reason that their BM framework could be used across multiple industry sectors. Dissimilar to other articles, (Benijts 2014) used the BM concept to explain the failure of a governmental corporation founded to finance sustainable companies. The author highlighted that a certain flexibility in the asset allocation was missing for success.

Two articles (Zhang, Zhang et al. 2015, Li, Zhan et al. 2016) used the BM concept to explain the functioning of transport-related public-private partnerships in China. Li et al. (2016) underlined how useful the integration of business innovations and governmental regulations is for the facilitation of electric vehicle deployments in cities. The authors used a multi-actor perspective as well as the BM canvas for an analysis and comparison of government-enterprise interactions for electric vehicle deployments (e-taxis and e-buses) in China. Zhang et al. (2015) presented a study of public bicycle sharing systems in five Chinese cities. City governments are highly important in this sector. Cities provide subsidies and administrational support to the typically privately-owned bicycle sharing companies and exercise direct influence on the cost structure of such BMs.

4.2.5 Technologies’ relations with interplays between GPs and BMs

Technologies sometimes play a role in the interplays between BMs and GPs in different ways. First, the influences of technologies were observed and discussed when new BMs challenge GPs. Biber, Light et al. (2017) made an extensive discussion of the interplays, especially on the platform economy. They categorised regulatory tools as a response to new BMs: block, free pass, apply old regulation, and develop new regulation. They then discussed new BMs such as Airbnb and Uber, which were triggered by new technological development. They asserted that regulators should strive to be neutral between incumbents and innovators and not favour one form of business organisation over another. Initially, Airbnb was an innovative BM that exploited a regulatory gap, namely, housing regulation allowing tenants to sublet their flats for a small number of times tax-free. Policymakers were then forced to adapt to unintended consequences like rising housing prices in areas with a high use of Airbnb, or decreased tax revenue from the hotel sector (Biber, Light et al. 2017).

Second, in contrast, technologies are in some cases expected to be developed by the interplays between BMs and GPs. Concerning autonomous vehicles, various BMs exist, from the traditional private ownership model to the access-based model, e.g., mobility as a service. These BMs and their related governmental regulations regarding liability, safety, and legislation have influenced one another. Subsequently, according to (Skeete 2018), automobile regulators are already in anticipation of a technology to become disruptive, e.g. fully autonomous cars by 2030.

Third, the literature describes a situation where technologies, BMs and GPs can be developed simultaneously. This can be regarded as a hybrid of the first and second ways explained above. Mwangoka, Marques et al. (2013) addressed a situation in the telecommunications sector, in particular, the potential exploitation of the unused spectrum resources of TV white spaces to deploy more wireless services. This was motivated by the uncertainties from technologies, BMs and regulatory policies that hindered the take-off of TV white spaces exploitation. They proposed a specific solution called the bicameral geo-location database together with four deployment scenarios, which were then evaluated from technological, business and regulatory prospects. This case implies that a certain technology can create relevance to the interplays between BMs and GPs.

5 Implications for circular economy

5.1 Overview

The purpose of this section is to connect the GP-BM interactions directly to CE. The chosen approach was to assign each paper to one of the six CE action areas of the ReSOLVE framework.

The largest group (17 out of 45 papers) refer to *regenerate*, i.e., the use of renewable resources and greater inclusion of biological cycles in production processes. Five papers were located next to the topic of *sharing* and related to the sharing economy. All three papers related to *optimise* dealt with energy service provision. Four papers were found to be related to *loop*, which is a category that addresses aspects that facilitate looping of products and materials through design, behavioural or technical measures. No paper was identified to relate to the *virtualise* category. Two papers exhibit interactions relevant for *exchange*, i.e., the replacement of materials and technologies with more resource-efficient alternatives. Finally, 14 papers could not be related to a CE topic as such, for example, effects of regulatory changes on the banking sector etc.

The interaction matrix (Table 1) has indicated that the type of GPs most affecting BMs are direct measures including regulatory/legislation command-and-control instruments, while economic, information and support instruments are influencing to a lesser extent. In particular, information GPs had the weakest impact and are not considered sufficient to influence a BM on their own. In terms of BM components, GPs affect most often the 'value proposition', 'key activities' and 'key partners' and to a high degree the 'cost structure' and 'revenue model'. Table 2 describes the information of the GP-BM interactions found in literature within the context of CE. The interactions are presented on the ReSOVLE framework and for each category the type of interaction and the CE application potential is expressed, taking into account the contextual and descriptive results of the previous section. More details on each ReSOLVE category are presented in the following sub-sections.

Table 2. Summary of interactions between governmental policies and business models in literature related to circular economy according to the ReSOLVE framework. Discussion points about the potential of practical application and implications are also presented.

CE element	Outcome/aim	GP-BM interaction in literature	CE potential application and related implications
Regenerate	*Shift to renewable energy and materials*	In a case of energy service providers, the determinants of the successful business deployment were affected by financial incentives; policy consistency; streamlining and facilitation of legal-administrative processes; and liberalisation of the sector (Huijben and Verbong 2013) - 8L and 9L.	In the transition to a CE, policy consistency and simplification of administrative requirements are high priority policy interventions, while financial incentives and regulatory framework liberalisation are viewed with caution, since the signals of such interventions are not always clear (Milios 2021). There is a variety of financial incentives, e.g. fiscal instruments and direct subsidies (or feed-in tariffs), both having related down-sides. Subsidies can create an artificial business environment which would not be viable in a long-run, if not tested in market competition. On the other hand, taxes are only second-best policies for addressing resources due to their inherent impreciseness (Domenech and Bahn-Walkowiak, 2019). Therefore, a CBM could take advantage of a stable policy framework that states clearly the 'rules of the game' for a predictable time horizon; and of less complicated administrative requirements related to legal compliance and contracting. Economic instruments could act as a boost, especially at initial stages of BM transformation, but should not be relied upon for the longer-term development and establishment of a CBM.
		For electricity offerings, the way the electricity contracts are formulated played a critical role in the diffusion of renewables. Net metering and connecting payments to house ownership under different socio-economic circumstances lead to different policy support needs, e.g., bank loan conditions and subsidies (Strupeit and Palm 2016) – 8E, 8S, 9E, and 9S.	Socio-economic conditions and the market environment should be taken into consideration when developing a BM. When net savings and ownership of property is high in a certain context, then contracting and loan requirements must be different than in a context of low liquidity and fluid contractual obligations. Public subsidies might boost BM formulation and investment but this must be followed up by more concrete actions of BM deployment. Horizontal policy measures, in favour of CE activities, especially of a direct regulatory nature, might tilt the 'value proposition' and 'key activities' aspects of the BM more effectively than other policy approaches.
		For renewable energy BM diffusion, it is important that stable and reliable planning conditions for companies are in place. Also important are manageable administrative costs, e.g., standardised contracts (Overholm 2015) – 1L, 1E, 5L, 5S, and 7S.	Long-term stable regulatory framework as well as simplified administrative processes and standardised contracts can create the necessary environment for CBM implementation.

		In feed-in tariff systems, the gradual phase out of the financial support would be aided by stakeholders' training in management and trading of electricity markets (Herbes et al. 2017) – 5L, 8L, and 9L.	The importance of policy sequencing is also highlighted. A working BM can be aided by a variety of GPs according to its needs in a specific development phase. While feed-in tariffs aided the diffusion of the BM, its subsequent maintenance and proliferation is dependent in additional capabilities. Therefore, support in training and continuous improvement could be added in the policy mix for the CE transition.
		Control mechanisms are also important in regulating the energy demand of buildings (Ma et al. 2017) – 3S and 4L.	Although not a BM development mechanism, controls are always required to 'check' the functioning of the wider system in which the BM operates. Therefore, it is important to remember that effective control mechanisms can safeguard the effectiveness of applied policies as well as ensure a level playing field for all business actors in the economic system.
Share	*Maximize asset utilization*	In the case of bike sharing BMs the support of cities through investments, subsidies, infrastructure, advertising permits, police support etc. was key to the success of bicycle sharing in China (Zhang et al. 2015).	The papers related to the Share category show how important the collaboration between businesses and city governments is. Cities are the most appropriate actors to create the specific conditions needed by local innovative BMs to spur CE activities.
		In the Netherlands, a point of leverage in the BMs was that bike sharing systems were integrated within the wider public transport systems (van Waes et al. 2018) – 1L, 2L, 3L, 4L, and 7L.	In addition to providing enabling conditions for the development of CBMs, local authorities can integrate some services with public offerings, creating a circular ecosystem and legitimising the development and up-take of the BM from a wider public. This relation differs from the typical 'public-private partnership' in that the already established BM is integrated in the public system and not the other way around, where the public interest is investing for the development of a desired BM offering.
	Digitally enabled sharing of assets promote shared use	BM innovations cause policy disruptions. Accommodation sharing platforms took advantage of policy loopholes in the short-term rental regulations. Homeowners could occasionally rent out their places tax-free (Biber et al. 2017) Government supported facilitation of crowdfunding action as well as their regulation increased investment into renewable energies (Vasileiadou, Huijben et al. 2016), whereas in China crowd-funding was less successful as this	Legislation is not always ready to regulate emerging phenomena that have not been experienced before. In the case of sharing accommodation, the housing sector regulation was quite conservative, in a sense that it could not predict the effects of technological innovation in the housing market – a very traditional and predictable area of regulation. Several regulatory gaps were exploited by BM offerings creating conditions of intensive use and sharing of assets, creating increasing returns. Although such BMs have been criticised regarding their actual resource efficiency potential (Voytenko Palgan et al. 2017), nevertheless they have drawn attention to the disruptive nature of the 'platform economy' which in turn facilitated the laying down of rules that create a more just and transparent framework of operation for new entrants.

		financing vehicle is met with suspicion (Zhang 2016). – 1L, 2L, 3L, 4L, 5L, 6L, 7L, 8L, and 9L.	
Optimise	*Optimising system performance/ Decreasing resource usage*	Energy providers may switch from a sales-based to performance-based BM to increase the optimization potential for customer energy demand. Local planning authorities that implement low carbon strategies could enable this transition through a long-term strategic goal setting and regulation setting (Hannon et al. 2015) – 1L, 2I, 7L, 7I, 7S, 8L, 8E, 8S, and 9E.	Climate Plans and Circular Economy Strategies are increasingly becoming the norm for ambitious national, regional and local authorities which wish to advance their sustainability agendas. Within this strategic planning, public authorities have the ability to invest in upfront costs of low carbon equipment or subsidising the contracting process, promote informative policies and awareness raising, training for people to deliver and develop green contracts, and contract standardisation (Hannon et al. 2015). Therefore, there is a unique potential for systems' optimisation as long as public authorities act in a coordinated and scientifically sound way to respond to their environmental ambitions.
		Lack of a clear regulatory framework inenergy service companies incurs transaction costs, which is limiting business opportunities. Also, public efforts of standardising energy service contracts would limit costs (Klinke 2018) – 1I, 8L, 8E, 9L, and 9E.	Streamlining of legislation and simpler compliance and administration rules have the potential to reduce transaction costs and push down the overall operational requirements of companies, thus enabling them to redirect more resources and employ more capabilities towards a CBM.
		Through a reform in the energy sector in China, providers are allowed to keep a substantial share of the cost savings related to decreases of the customers' demand reductions (Zhang et al. 2017) – 1L, 2E, 5L, and 6L.	In this case, system optimisation is directly translated to money savings for the efficient company and thus acts as a directly accountable and highly visible incentive that can drive further operational optimisation and BM readjustments.
Loop	*Prioritizing loops (hierarchy)*	Support of BMs for extended product lifetimes through demonstration efforts and pilot projects to show the operational ability of second-life batteries and increase the willingness to pay for related offerings (Jiao and Evans 2016) – 1L, 1E, 2E, 5E, 7L, and 8E.	Innovation funding and support of research and demonstration activities is a fundamental policy support for bringing novelty into the market. In the transformative nature of CE, it is anticipated that a series of innovations, both in technologies and BMs, would be required.. This is highly relevant for high-risk developments, but also for streamlining softer aspects of CE, i.e., behaviour change and social acceptance.
		"Old for new" promotions of producers, within EPR systems, where old products are given back when new ones are	The reconfiguration of the EPR BM in this case allows for higher gains in material resource efficiency and revenues by increasing the collection of old products and prioritising the re-use and re-sell of the products instead of

		purchased improved the collection rates of old phones in China. The re-selling of these phones either to secondhand markets or into formal recycling process created extra revenue streams for producers (Tong et al. 2018) – 1L and 5E.	recycling. The EPR regulatory framework is embedded within the waste hierarchy principle, although the recycling option is mostly used due to cost efficiency in operations. However, cost efficiency does not always relate to resource efficiency and thus there is still significant potential for advancing to higher utilisation of resources within the EPR schemes. Potentially, additional measures would be required to improve the material efficiency of EPR, such as the introduction of fee adjustments in the system according to resource efficiency operations (Micheaux and Aggeri 2021).
		SMEs find it harder to comply with environmental legislation than larger organizations. SMEs are also embedded in broader supply chains that can make it difficult or impossible for them to implement circular activities (Rizos et al. 2016).	Regulatory compliance and control over suppliers is overextending the resources and capabilities of businesses which can respond according to their size and width of operations. SMEs are inherently unable to control circumstances away from their immediate BM. Simple compliance rules and explicit supply chain requirements (even with the use of labels or certifications) are required for an inclusive and just transition to CE which does not leave anyone behind.
	Remanufacture/refurbish products or components	A 'Gap-exploiter' BM for mobile phones takes advantage of a loophole in private insurance rules about proof of damage for reparations. In collaboration with an insurance provider, damaged phones are collected and refurbished for the second-hand market. This is possible only through the identified regulatory weakness due to high labour and infrastructure costs that would make this BM not competitive otherwise (Whalen et al. 2018) – 5L, 7L, and 8L.	In a business environment with significant cost constrains, a BM needs to manoeuvre accordingly to overcome these challenges, by opening up to 'key partners' and 'key activities' that might bridge the cost gap and increase competitiveness. However, this could also be achieved by targeted policy interventions that respond timely to such business economic constrains. In the case of high labour costs – a common phenomenon in developed markets – it is likely that a preferential taxation regime for CE activities could facilitate an upscale of such operations. Moreover, in absence of other cost reducing measures, municipalities or other regional authorities could share the burden of developing appropriate collection infrastructure for the acquisition of used products simpler and cheaper by adding specific collection systems for EoL products to the already existing recycling systems. Finally, municipalities could also introduce specific criteria for refurbished or remanufactured products in their procurement processes, thus offering also a further economic incentive for CBMs to develop and compete in the market with linear offerings (Whalen et al. 2018).
Virtualise	*Replacing physical products and services with virtual services*	No interactions identified in literature in relation to this CE activity.	N/A

Exchange	*Replacing product centric delivery models with new service-centric ones*	Antitrust rules reverse the transition from product sales to servitization in a case of imaging equipment (Finne et al. 2013) – 5L, 6L, 7L, and 9L.	Antitrust rules, intellectual property rules, ownership definitions under insurance contracts and public procurement rules have the potential to be formulated in a way that allows for a variety of product/service provision – not only within the traditional “product ownership” model. Further ways of fulfilling a function or service can be explored, i.e., through product-service system offerings (Wasserbaur et al. 2020).
	Replacing old technologies with new, including renewable materials inputs	Public subsidies for electric vehicles (EV) and tax exemptions for e-taxi operations promoted the diffusion of EV business offerings (Li et al. 2016) – 1L, 2L, 4L, 5L, 6L, 7L, 8E, and 9E.	Economic policy instruments, such as subsidies and tax exemptions have the potential to significantly affect the cost structure and revenue model of BMs. A preferential economic environment can reinforce CE business activities, but attention is needed in that the BMs become gradually competitive and can effectively substitute existing solutions, and to avoid remaining dependent on the economic subsidies for their survival.
		Public-private partnerships of regional authorities with local manufacturers favours the scale-up of EV offerings, however does not allow for the provision of alternative business offerings (protectionism) (Li et al. 2016) – 1L, 2L, 4L, 5L, 6L, 7L, 8E, and 9E.	Public-private partnerships can create the necessary stability conditions a BM needs to adjust in a new CE “reality” and potentially scale up to substitute existing business configurations. However, it is important to highlight the fact that phenomena of unlawful competition and protectionism can act against the goal of CE transition and be largely counterproductive in the long-run.

Note: papers cited in the column for GP-BM interaction in literature are associated with the sings according to the nine BM aspects and the four GP categories, where applicable; e.g., 8L means that the paper appeared in the row of 8. cost structure aspect and the column of L (Legislation/regulation/command-and-control) category of Table A1.

6 Conclusions

This paper presented one of the first works that analysed the interplays between GPs and BMs on the CE context by the systematic literature review, including literature synthesis. As interaction between GPs and BMs is no phenomenon confined to the CE, the bulk of the reviewed articles is not per se affiliated to CE; yet insights gained from outside the CE context are found useful for the CE. In concrete terms, mapping the interactions in a matrix consisting of four policy categories and nine BM components revealed that relevant recently published articles were increasingly focussed on interactions between regulations and value propositions as well as upon regulations and financial aspects of BMs. Studies using the BM canvas as an analytical tool have also revealed that, typically not all BM components are affected equally by GPs. Most exposed to policies were revenues and cost structure, command-and-control policies are more often researched than market policy measures. It was also found that nearly half of the relevant reviewed research dealt, to some degree, with technology and how technology affected the BM-policy nexus and that the majority of the reviewed articles were relatable to the topic of sustainability. It was further shown that the interactions between GPs and BMs are dynamic. These insights can be used for adapting GPs that are aimed to facilitate CEs in a more effective way. Therefore, suggested future research could apply longitudinal studies or even dynamic simulation methods to understand better the dynamics behind the interaction phenomena between GPs and BMs.

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Appendix

Table A1. The interaction matrix presents the interactions between GPs and BM aspects identified in the reviewed articles. This visualisation includes references. A simplified version is used in the main text (see Table 1).

GP category / BM aspect		Legislation/Regulation/ command-and-control (L)	Economic and fiscal (E)	Information-based and communication-based (I)	Support mechanisms and capacity building (S)
1.	**Value propositio n**	(Liang and James 2009, Mwangoka, Marques et al. 2013, Hannon, Foxon et al. 2015, Overholm 2015, Plepys, Heiskanen et al. 2015, Zhang, Zhang et al. 2015, Jiao and Evans 2016, Kanda, Sakao et al. 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Yun, Won et al. 2016, Zhang 2016, Biber, Light et al. 2017, Burger and Luke 2017, Jovanovic, Arnold et al. 2017, Zhang, Jiao et al. 2017, Berti and Casprini 2018, Dewitte, Billows et al. 2018, Skeete 2018, Tong, Tao et al. 2018, van Waes, Farla et al. 2018, Yao, Zhong et al. 2018)	(Christensen, Wells et al. 2012, Overholm 2015, Zhang, Zhang et al. 2015, Jiao and Evans 2016, Zhang 2016, Burger and Luke 2017, de Oliveira, Mendes et al. 2018, Li, Zhang et al. 2018, Yao, Zhong et al. 2018)	(Klinke 2018, Pereira, Specht et al. 2018)	(Ernkvist 2015, Karlsson, Halila et al. 2017)
2.	**Customer segment**	(Mwangoka, Marques et al. 2013, Huijben, Verbong et al. 2016, Jiao and Evans 2016, Kanda, Sakao et al. 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Berti and Casprini 2018, Li, Zhang et al. 2018, van Waes, Farla et al. 2018)	(Jiao and Evans 2016, Burger and Luke 2017, Zhang, Jiao et al. 2017, Li, Zhang et al. 2018)	(Hannon, Foxon et al. 2015)	(Karlsson, Halila et al. 2017)
3.	**Customer relationsh ips**	(Huijben, Verbong et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Paulet 2018, van Waes, Farla et al. 2018)			(Karlsson, Halila et al. 2017, Ma, Billanes et al. 2017)
4.	**Key resources**	(Engelken, Romer et al. 2016, Gabriel and Kirkwood 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017) (Kanda, Sakao et al. 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Ma, Billanes et al. 2017, van Waes, Farla et al. 2018)			(Karlsson, Halila et al. 2017, Li, Zhang et al. 2018)
5.	**Key activities**	(Finne, Brax et al. 2013, Angeli 2014, Overholm 2015, Plepys, Heiskanen et al. 2015, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Herbes, Brummer et al. 2017, Jovanovic, Arnold et al. 2017, Zhang, Jiao et al. 2017,	(Jiao and Evans 2016, Li, Zhang et al. 2018, Tong, Tao et al. 2018, Zhao, Chang et al. 2018)		(Overholm 2015, Lam and Yu 2016, Karlsson, Halila et al. 2017)

	Dewitte, Billows et al. 2018, Li, Zhang et al. 2018, Skeete 2018, Whalen, Milios et al. 2018, Zhao, Chang et al. 2018)			
6. Distribution Channels	(Finne, Brax et al. 2013, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Zhang, Jiao et al. 2017)			(Karlsson, Halila et al. 2017)
7. Key partners	(Finne, Brax et al. 2013, Mwangoka, Marques et al. 2013, Angeli 2014, Hannon, Foxon et al. 2015, Plepys, Heiskanen et al. 2015, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Jiao and Evans 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Dewitte, Billows et al. 2018, van Waes, Farla et al. 2018, Whalen, Milios et al. 2018)	(Huijben, Verbong et al. 2016)	(Hannon, Foxon et al. 2015)	(Hannon, Foxon et al. 2015, Overholm 2015, Gabriel and Kirkwood 2016, Karlsson, Halila et al. 2017, Li, Zhang et al. 2018)
8. Cost structure	(Huijben and Verbong 2013, Hannon, Foxon et al. 2015, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Burger and Luke 2017, Herbes, Brummer et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Dewitte, Billows et al. 2018, Klinke 2018, Paulet 2018, Pereira, da Silva et al. 2018, Platt, Workman et al. 2018, Whalen, Milios et al. 2018)	(Hannon, Foxon et al. 2015, Huijben, Verbong et al. 2016, Jiao and Evans 2016, Lam and Yu 2016, Li, Zhan et al. 2016, Strupeit and Palm 2016, Burger and Luke 2017, Serradilla, Wardle et al. 2017, de Oliveira, Mendes et al. 2018, Klinke 2018, Li, Zhang et al. 2018)		(Hannon, Foxon et al. 2015, Strupeit and Palm 2016, Karlsson, Halila et al. 2017, Muller and Welpe 2018)
9. Revenue model	(Finne, Brax et al. 2013, Huijben and Verbong 2013, Satchwell, Mills et al. 2015, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Marconatto, Barin-Cruz et al. 2016, Vasileiadou, Huijben et al. 2016, Biber, Light et al. 2017, Burger and Luke 2017, Herbes, Brummer et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Klinke 2018, Paulet 2018, Platt, Workman et al. 2018)	(Tuunainen 2011, Hannon, Foxon et al. 2015, Satchwell, Mills et al. 2015, Engelken, Romer et al. 2016, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Lam and Yu 2016, Li, Zhan et al. 2016, Strupeit and Palm 2016, Burger and Luke 2017, Klinke 2018)		(Karlsson, Halila et al. 2017) (Strupeit and Palm 2016, Muller and Welpe 2018)

Note: The data of the references that are not cited in the main text are shown below.

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Focus 2:

Taxation in the Circular Economy

2023 Fiscal Review Committee:

Tax as a force for good

Aligning tax systems with the SDGs
and the inclusive circular economy

CASE STUDY BANGLADESH

The Ex'tax Project
In cooperation with Cambridge Econometrics
Supported by C&A Foundation

The Ex'tax Project
In cooperation with Cambridge Econometrics

Colophon

Lead author
Femke Groothuis (The Ex'tax Project)

Main partners
Cambridge Econometrics, C&A Foundation

Research and editing
Valérie van de Luitgaarden, Peter Gersen (The Ex'tax Project)

Design
Frank Paats (www.frankpaats.nl)

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The Ex'tax Project (2019), Tax as a force for good: Aligning tax systems with the SDGs and the inclusive circular economy. Case study Bangladesh.

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Abstract

This study analyses opportunities to align tax systems with the goals of the SDGs and the inclusive circular economy, by putting a price on natural resource use and pollution and using the revenues to lower the tax burden on labour and increase (social) spending.

The case study focusses on Bangladesh. Bangladesh has one of the largest gaps between tax revenue and GDP. The country is highly prone to climate disruption. Pollution levels are high and renewable energy sources provide only a fraction of energy needs. Bangladesh has a large, growing and resilient population. The country has a proven track record of effectively addressing poverty and other challenges. Sustainable inclusive growth is a major national priority.

Cambridge Econometrics has modelled some of the impacts of two preliminary scenarios, which include introducing a price on carbon emissions and phasing out certain fossil fuel subsidies, while using the revenues to invest in clean technologies, infrastructure and income support. The modelling suggests that by 2025, such tax reforms could lead to higher GDP and employment levels, while reducing carbon emissions and energy imports. The transition can be highly progressive when revenues are mainly used to increase social spending.

The findings suggest that tax reform can be a viable strategy to reach the dual goal of socio-economic development and environmental protection.

Executive Summary

Bridging the SDG finance gap

This is the era of the Sustainable Development Goals (SDGs); an era of unprecedented global social and environmental challenges. The most daunting task will be to adapt the metabolism of our economies to match the carrying capacity of the earth and stay well below 2°C global warming. We face equally important social challenges in our societies, including enabling a growing population to develop to their full potential and find decent work. According to the United Nations, achieving the SDGs is going to cost US$5-6 trillion a year. Developing countries alone face an annual financing gap of $2.5 trillion. Official development assistance (ODA) is just $150 billion per year, and on a downward trend. Private flows of investment are also considerably below the level of SDG investment needs. This means there is a massive financing gap.

Tax and the circular economy

Aligning economic growth with the goals of the SDGs will be key. Therefore, a shift is needed from the linear 'take-make-waste' economy, towards an inclusive circular economy, which is regenerative, carbon neutral and distributive. Such circular economies require labour- and knowledge-intensive activities (e.g. repair and maintenance services, recycling, refurbishment and R&D), which could significantly contribute to job creation. Currently, however, governments tend to increase the tax burden on human labour, which incentivises businesses to reduce labour input. At the same time, governments put low or no taxes on natural resource use (such as carbon emissions, fossil fuels and water), thereby leaving resource use unrestrained, causing overconsumption, pollution and waste.

Leapfrogging tax systems to the SDG era

Given the high unemployment rates in low- and middle-income countries, increasing the tax burden on labour may not necessarily be the best option to raise revenues sustainably. Could taxing pollution rather than people, as advocated by UN Secretary-General António Guterres, be a way of 'leapfrogging' tax systems to the SDG era? Studies indicate that such tax reform (also known as Environmental Tax Reform) can indeed have positive economic, social and environmental impacts. A World Bank study, for example, demonstrated that a domestic carbon tax of $30 per tonne of CO_2 would provide the resources to more than double current levels of social assistance in 60 countries. Over the years, many researchers and international organisations have called for tax reform; putting a price on pollution and resources and using the revenues to lower the tax burden on labour and increase (social) spending.

Opportunities and risks of tax reform

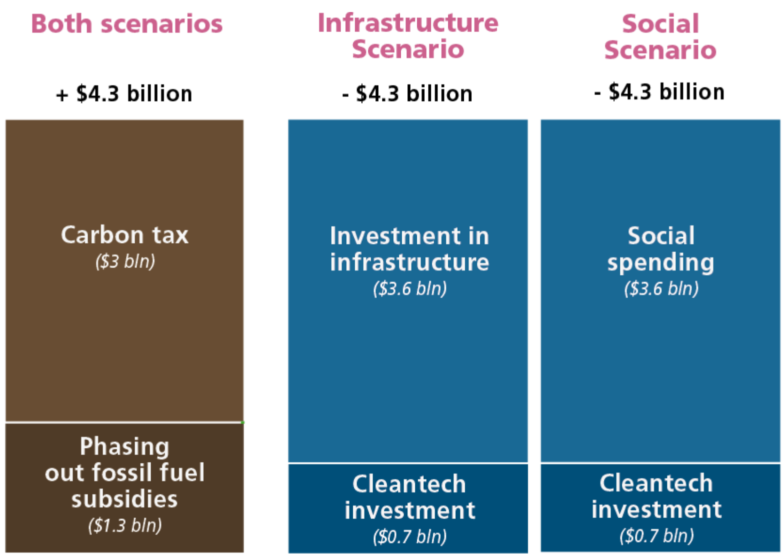
The goal of this study is to analyse opportunities and risks of aligning tax policy with the goals of the inclusive circular economy in low- and middle-income countries, focussing on Bangladesh as the first case study. Bangladesh has one of the largest gaps between tax revenue and GDP. Green taxes (including restructuring of fossil fuel subsidies), could help raise much-needed tax revenues. The country is highly prone to climate disruption, pollution levels are high and renewable energy sources provide only a fraction of energy needs. It has a large, growing and resilient population of 165 million, with 2 million youths entering the job market every year. The country has a proven track record of effectively addressing poverty and other challenges. Sustainable inclusive growth is a major national priority.

Cambridge Econometrics has modelled some of the impacts of two preliminary scenarios, which include putting a price on carbon emissions and abolishing fossil fuel subsidies, while using the revenues to invest in clean technologies, infrastructure and social spending. The modelling suggests that by 2025, such tax reforms could lead to higher GDP and employment levels, while reducing carbon emissions and energy imports. The transition can be highly progressive when revenues are mainly used to increase social spending.

Two preliminary scenarios

For the purpose of this study, Cambridge Econometrics developed the 'FRAMES: Bangladesh' model, to estimate potential green tax revenues and macro-economic impacts of tax reform scenarios. The Ex'tax Toolkit and Methodology were used to develop two preliminary scenarios (see Figure A). Leading factors in this process were, amongst others, the national priorities of Bangladesh, data availability and the scope of the FRAMES model. The measures are assumed to be introduced gradually from 2020, to reach to reach the full measures by 2024. In the year 2025, both scenarios are expected to raise $4.3 billion in revenues by 1) introducing a carbon tax of $30 per tonne of CO_2 emitted by industries and the power sector, and 2) phasing out oil and natural gas subsidies for industries and power generation. In the modelling, every year, the revenues are fully recycled. In the *Infrastructure Scenario*, all revenues are recycled through investments in clean technology and infrastructure. In the *Social Spending Scenario* (or *Social Scenario*), all revenues are recycled through investments in clean technology and social spending targeted towards the lowest two income quintiles. In both scenarios, the cleantech investments are targeted towards the textiles sector (Bangladesh's most important export sector).

Figure A: The Infrastructure Scenario and the Social Scenario (in 2025, Bangladesh)



Source: Model projections, Cambridge Econometrics 2019.

Figure B provides some key results over the 2020-2025 period, demonstrating decoupling effects in the scenario, as GDP is higher, and emissions are lower. An increase in employment is observed in each scenario.

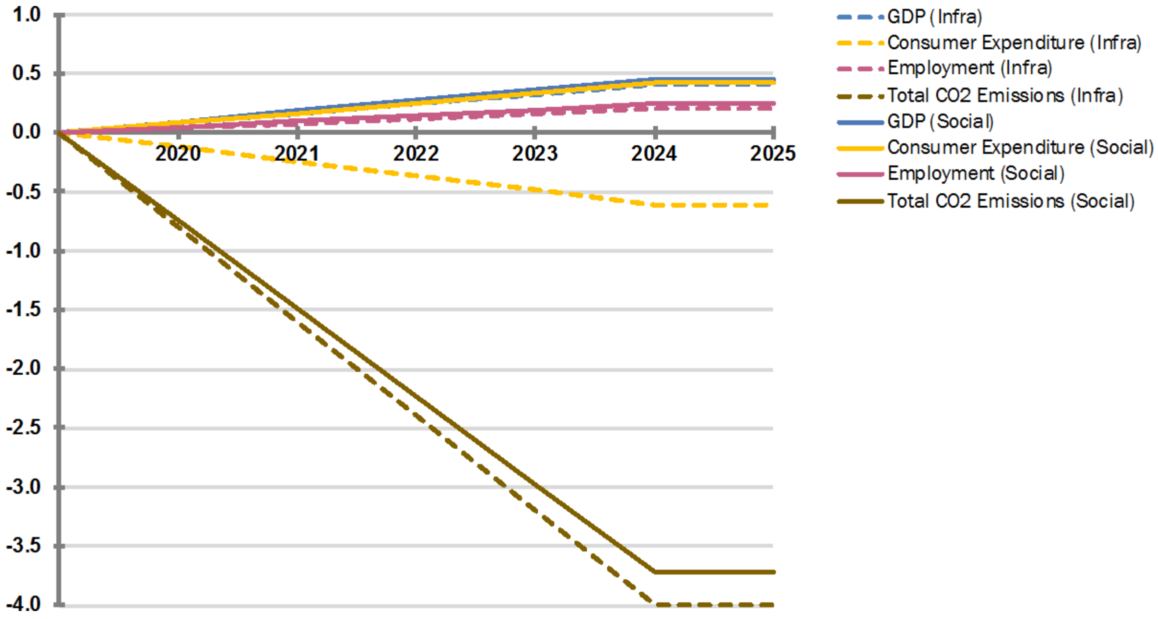
Cumulative results

Over the 2020-2025 period, the scenarios add $6.9 billion (in the *Infrastructure Scenario*) and $7.8 billion (in the *Social Scenario*) to GDP, compared to business as usual. Additional results over the six-year period are:

- **Resource mobilisation.** Phasing out fossil fuel subsidies could potentially raise $4.7 billion in domestic resources, while a carbon tax could add another $10.6 billion in domestic resources.
- **Job creation.** Both scenarios show increases in employment (540,000 and 670,000 years of employment respectively).
- **Carbon emission reductions.** Both scenarios demonstrate a significant reduction in carbon emissions (saving 19.9 and 18.5 megatonnes of carbon respectively).

- **Savings on energy imports.** In both scenarios, Bangladesh saves significant amounts on energy imports ($429 million and $405 million respectively).
- **Public investments.** In the *Infrastructure Scenario* $12.8 billion is invested in infrastructure. In the *Social Scenario*, $12.9 billion is invested in social protection. Cleantech investments in both scenarios are to $2.6 and $2.5 billion respectively over the 2020-2025 period.

Figure B: Overall result: decoupling (2020–2025, % difference from baseline, Bangladesh)



Source: Model projections, Cambridge Econometrics 2019.

Distribution of benefits and costs

As with any reform, the benefits and costs will not be spread evenly. The modelling results suggest that a progressive impact with higher benefits (in relative terms) for lower income households is possible, particularly in the *Social Scenario*. For businesses, in the *Infrastructure Scenario*, the largest increases in output, both in relative and absolute terms, are in the construction, manufacturing (excluding textiles), mining and quarrying sectors. These sectors benefit from the investments in infrastructure. Some of the manufacturing companies in the supply chain also benefit. Output falls marginally in sectors which are supplying consumer final demands, such as retail. In the *Social Scenario,* most sectors demonstrate an increase in output as they benefit from higher local consumer spending. Manufacturing and construction also have relatively high increases, because of the investment in cleantech for textiles.

Results for the textiles sector

In both scenarios, the textiles sector shows a slight negative result in terms of gross output (0.24% and 0.15% respectively) by 2025, but overall, the Bangladesh economy would be stronger and more competitive in terms of carbon intensity and energy import dependency. Also, it's important to note that the competitiveness impacts of the cleantech investments (totalling more than $2.5 billion) are not yet captured in the model. Bangladesh is the world's second-largest exporter of clothing, and the sector represents 80 percent of foreign earnings. As one of the most polluting industries, operation in a fast-changing global market, the global textiles industry is at a crossroads; continuing the linear model (while imposing external costs to society and future generations), or shifting to circular models, and adapting to changing circumstances. In light of global trends, tax reform could be a way to reduce risks and future-proof the sector.

The key message from the results is that it is possible to design policy measures that reduce harmful emissions and final energy consumption, while at the same time stimulating the economy of Bangladesh, creating jobs and (in the *Social Scenario*) increasing income for the lowest income groups. These results demonstrate that Bangladesh doesn't need to choose between development and environment.

Balancing the interests of stakeholders

The scenarios presented in this study do not claim to be a blueprint or short-term solution, but are a medium- to long-term pathway, to assist in the process of balancing the interests of different stakeholders. Any implementation pathway should be researched and then monitored by the designated national institutions with full access to national statistics. This study is meant to set an example for similar analyses in other countries—particularly those with low- and middle-incomes, facing similar challenges.

Prosperity based on human capital

The foundations of modern tax systems were laid down in the era of the industrial revolution; before globalisation and mass consumption, before the emergence of climate disruption and water supply risks, and before digitisation and automation. In the SDG era it is vital for governments to serve the interests of the people and business at the same time, and to fairly distribute risks and opportunities. Smart tax policies could help countries to 'leapfrog' into the SDG era. Stakeholders, businesses, governments and NGOs should work together to turn tax into a 'force for good' and help build modern tax systems that enable prosperity based less on natural resource use and more on the abundance of human capacities and talents. For this is growth that can be sustained by generations to come.

Introduction

Bridging the SDG finance gap

This is the era of the Sustainable Development Goals (SDGs); an era of unprecedented global social and environmental challenges. The most daunting task will be to adapt the metabolism of our economies to match the carrying capacity of the earth and stay well below 2°C global warming. We face equally important social challenges in our societies, including enabling a growing population to develop to their full potential and find decent work. According to the United Nations, achieving the SDGs is going to cost US$5-6 trillion a year. Developing countries alone face an annual financing gap of $2.5 trillion while Official Development Assistance (ODA) is just $150 billion per year, and on a downward trend. Private flows of investment are also considerably below the level of SDG investment needs. This means there is a massive financing gap.

Tax and the circular economy

Aligning economic growth with the goals of the SDGs will be key. Therefore, a shift is needed from the linear 'take-make-waste' economy, towards an inclusive circular economy, which is regenerative, carbon neutral and distributive. Such circular economies require labour- and knowledge-intensive activities (e.g. repair and maintenance services, recycling, refurbishment and R&D), which could significantly contribute to job creation. Currently, however, governments tend to increase the tax burden on human labour, which incentivises businesses to reduce labour input. At the same time, governments put low or no taxes on natural resource use (such as carbon emissions, fossil fuels and water), thereby leaving resource use unrestrained, causing overconsumption, pollution and waste.

Leapfrogging tax systems to the SDG era

Given the high unemployment rates in low- and middle-income countries, increasing the tax burden on labour may not necessarily be the best option to raise revenues sustainably. Could taxing pollution rather than people, as advocated by UN Secretary-General António Guterres, be a way of 'leapfrogging' tax systems to the SDG era? Studies indicate that such tax reform (also known as Environmental Tax Reform (ETR)) can indeed have a positive economic, social and environmental impact.

Opportunities and risks of tax reform

The goal of this study is to analyse opportunities and risks of aligning tax policy with the goals of the inclusive circular economy in low- and middle-income countries, focussing on Bangladesh as the first case study. Bangladesh has one of the largest gaps between tax revenue and GDP. The country is highly prone to climate disruption, pollution levels are high and renewable energy sources provide only a fraction of energy needs. It has a large, growing and resilient population and the country has a proven track record of effectively addressing poverty and other challenges. Sustainable inclusive growth is a major national priority. This study is meant to be a steppingstone for similar analyses in other countries, facing similar challenges.

Prosperity based on human capital

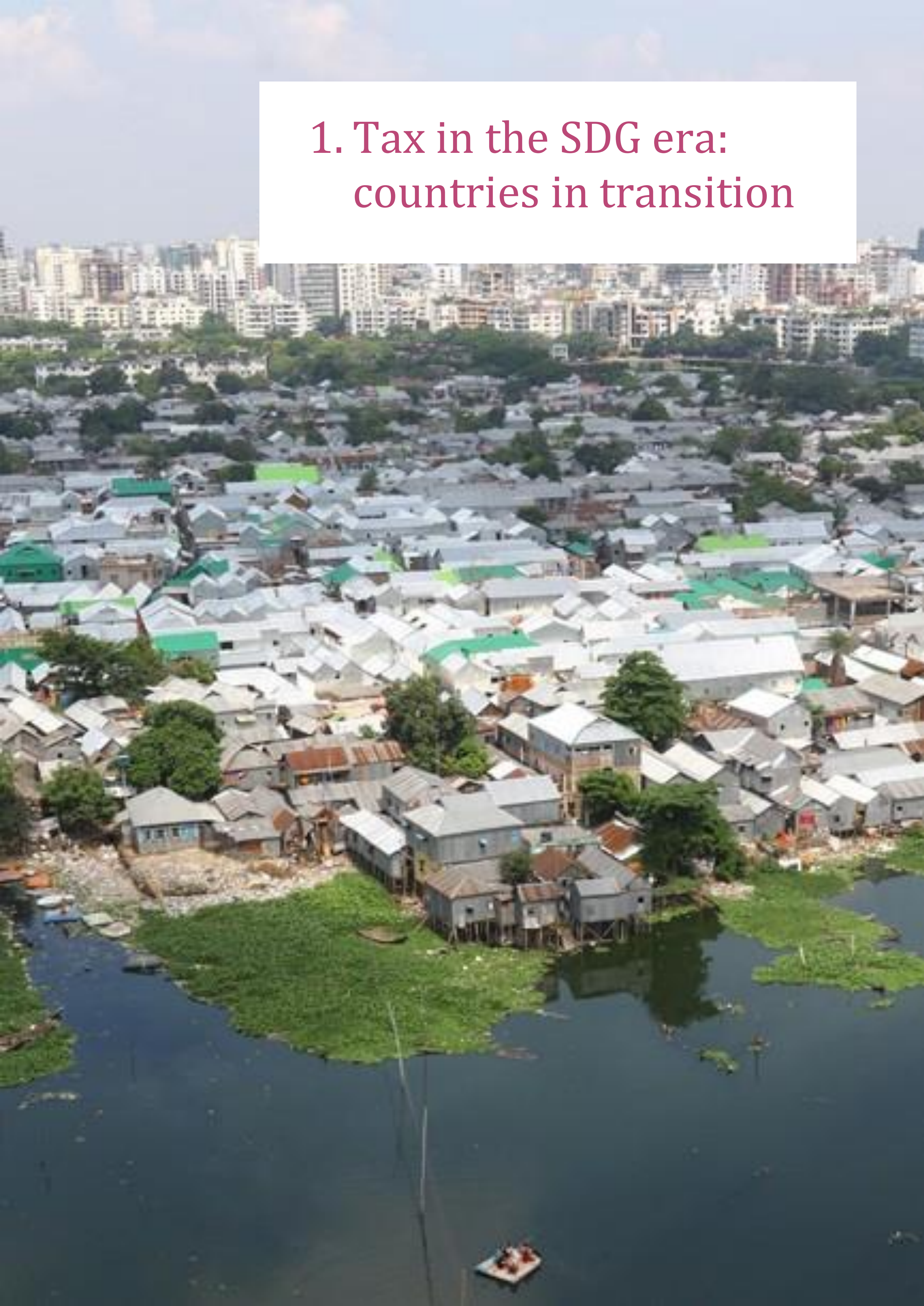
Turning tax into a 'force for good' should mean building modern tax systems that enable prosperity based less on natural resource use and more on the abundance of human capacities and talents. This is not a simple task, especially in countries with low- and middle-incomes, which face the multiple challenge of developing the economy and social systems while at the same time preserving natural resources. This study confirms that countries may not need to choose between those goals.

The structure of this report

Chapter 1 looks into the challenges in the 'SDGs era', the role of tax systems in achieving the SDGs and the shift from the current linear economic systems towards circular and inclusive economies. Chapter 2 provides an overview of the geographic, socio-economic, environmental and fiscal context in Bangladesh. Chapter 3 introduces the Ex'tax approach, and how two preliminary scenarios were developed for the case study of Bangladesh. Chapter 4 provides the key macro-economic modelling results. Chapter 5 explores the implications of tax reform for the Bangladeshi textiles industry in the context of global megatrends. The final chapter 6 includes recommendations for next steps.

It should be emphasised that the scenarios in this study are not a blueprint for implementation. They are meant to provide directions on how tax systems can be rationalised in light of the SDGs and the circular economy and what the potential impacts are. Any implementation pathway should be researched and then monitored by the designated national institutions with full access to national statistics.

1. Tax in the SDG era: countries in transition



This chapter explores how tax systems in general need to be updated in order to support the SDGs. Value Extracted Tax (in short: Ex'tax) is the proposal to increase taxes on natural resource use and pollution and using the revenues to lower the tax burden on labour and increase (social) spending. Such tax reform aligns financial incentives with economic growth based on the abundance of talents and capabilities of people, instead of natural resources.

1.1 The SDGs and the importance of tax reform

Interconnected social and environmental challenges

Humanity is facing unprecedented challenges (Box 1 provides a selection). The most daunting task will be to adapt the metabolism of our economies to match the carrying capacity of the earth and stay below 1.5°C of global warming. According to the latest Intergovernmental Panel on Climate Change (IPCC) report, global carbon emissions must start to reduce well within 12 years if we are to prevent large-scale natural and human risks from becoming irreversible reality.[1] We face equally important social challenges in our societies, including enabling a growing global population[2] to fulfil their basic needs, develop their full potential and find decent work. Governments need coherent strategies to deal with these megatrends.[3]

Box 1: Social and environmental megatrends (a selection)

Pollution kills 9 million people each year, with most of those deaths in low- and middle-income countries.[4]

Climate change hits the poorest people the hardest. As the effects of climate change worsen, escaping poverty becomes more difficult.[5]

Water scarcity affects nearly half the world's population.[6] Climate change is projected to further reduce water availability in many water scarce regions.[7]

Biodiversity is severely under threat; one million species of animal and plants face extinction.[8]

Food: One-third of all food produced for human consumption is lost or wasted globally – while at the same time, almost one billion people go hungry.[9]

Plastics: A truckload of plastic waste is dumped in the oceans every minute, which means that in a few decades there will be more plastics than fish in the oceans.[10]

Unemployment is a reality for 170 million people in the world today.[11] In addition, 140 million people are classified as 'underutilized labour'. Almost 700 million workers in low- and middle-income countries are living in extreme or moderate poverty (i.e. having to live on less than $3.20 per day in PPP terms).[12]

The Sustainable Development Goals

In 2015, the 193 countries of the United Nations (UN) General Assembly adopted the 2030 Development Agenda titled *Transforming our world: the 2030 Agenda for Sustainable Development*.[13] The agenda sets out 17 ambitious Sustainable Development Goals (the SDGs or Global Goals) that integrate social issues (such as fighting poverty and improving global health) and specific environmental issues (such as combating climate change) (see Box 2). As humanity's 'to do list', the SDGs will dominate the global agenda for the upcoming decades.

Financing the SDGs

According to the UN, achieving the SDGs is going to cost $5 to 6 trillion a year. Developing countries alone face an annual financing gap of $2.5 trillion.[14] Since Official Development Assistance (ODA) is $153 billion per year, the gap is huge.[15] Overall, ODA levels have fallen since 2016 for the second year in a row,[16] and only five countries met or exceeded the UN benchmark for ODA contributions of at least 0.7 percent of gross national income.[17] Private financing flows (including foreign direct investment, institutional investing, remittance (the money sent home by immigrants), foundations, microfinance and private equity) are higher than public flows, but they are mostly received by developed economies and they are considerably below the level of incremental SDG investment needs.[18]

Challenges in collecting taxes

Between 50 percent and 80 percent of what is required for the SDGs in low- and middle-income countries would need to come from domestic resources.[19] Taxation will be a key instrument in financing the SDGs, but the regions that are most in need of resources face significant challenges in collecting taxes:

> *"The rate of taxation (ratio of tax revenue to GDP) in the least developed countries declined from a peak of 11.1 per cent in 2012 to 8.8 per cent in 2016. Countries in sub-Saharan Africa faced a similar trend: a decline from 14.9 per cent in 2006 to 10.7 per cent in 2016." (United Nations 2018)*[20]

Research indicates that tax revenues above 15 percent of a country's GDP are critical for economic growth and, ultimately, poverty reduction.[21] In 2016, within the group of emerging countries with tax-to-GDP ratios below 15%, Nigeria had the largest tax-revenue gap, followed by Indonesia and Bangladesh. The total tax-revenue gap in the top-20 countries was $180 billion (compared to ODA of $46 billion).[22]

Box 2: The Sustainable Development Goals

Goal 1. End **poverty** in all its forms everywhere.

Goal 2. End **hunger**, achieve food security and improved nutrition and promote sustainable agriculture.

Goal 3. Ensure **healthy lives** and promote well-being for all at all ages.

Goal 4. Ensure inclusive and equitable quality **education** and promote lifelong learning opportunities for all.

Goal 5. Achieve **gender** equality and empower all women and girls.

Goal 6. Ensure availability and sustainable management of **water and sanitation** for all.

Goal 7. Ensure access to affordable, reliable, sustainable and modern **energy** for all.

Goal 8. Promote sustained, inclusive and sustainable **economic growth**, full and productive employment and **decent work** for all.

Goal 9. Build resilient **infrastructure**, promote inclusive and sustainable **industrialization** and foster **innovation**

Goal 10. Reduce **inequality** within and among countries.

Goal 11. Make **cities** and human settlements inclusive, safe, resilient and sustainable.

Goal 12. Ensure sustainable consumption and production patterns.

Goal 13. Take urgent action to combat **climate change** and its impacts.

Goal 14. Conserve and sustainably use the **oceans, seas and marine resources** for sustainable development.

Goal 15. Protect, restore and promote sustainable use of terrestrial **ecosystems**, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt **biodiversity** loss.

Goal 16. Promote **peaceful** and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Goal 17. Strengthen the means of implementation and revitalize the **global partnership** for sustainable development.[23]

Tax policy reform mentioned in four SDG targets

Taxes are explicitly mentioned in the targets of four SDGs (see Figure 1):

- The first target of **SDG 1 (No Poverty)** is to *"Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions."*
- **SDG 10 (reducing Inequality)** includes target 10.4: *"Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality."*
- **SDG 12 (sustainable consumption and production)** includes target 12.C: *"Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and*

minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities."

- **SDG 17 (Partnership for the Goals)**, target 17.1, again mentions the need to *"Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection."*

Taxation strongly connected to the SDGs

According to the *Platform for Collaboration on Tax* (a joint initiative of the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), the UN and the World Bank), taxation is a significant factor in 10 of the 17 SDGs. Taxes and the SDGs are connected in multiple ways:

> *"(1) taxes generate the funds that finance government activities in support of the SDGs; (2) taxation affects equity and economic growth; (3) taxes influence people's behavior and choices, with implications for health outcomes, gender equity, and the environment; and (4) fair and equitable taxation promotes taxpayer trust in government and strengthens social contracts that underpin development."*[24]

Figure 1: Tax policy targets in the SDGs

Source: United Nations (2015), Transforming our world: the 2030 Agenda for Sustainable Development. https://sustainabledevelopment.un.org/content/documents/21252030 Agenda for Sustainable Development web.pdf

Not simply a matter of taxing more

Mobilizing domestic resources is not simply a matter of taxing more:

> *"it's also about taxing better by expanding the tax base, ensuring an appropriate distribution of the tax burden among taxpayers, simplifying and improving the efficiency of tax administration, bringing tax laws up to date, and making sure that tax administrators know how to audit local and multinational companies."(World Bank 2018)*[25]

Total ODA for capacity-building and national planning amounted to $20.4 billion in 2016 (18% of total aid).[26]

A $12 trillion business opportunity

It may be clear that the massive investment gap will not be met by public finances alone and higher private sector investment will be indispensable.[27] Governments, corporations and organizations are now exploring how to make an impact and how to measure progress towards achieving the SDGs. According to a report by the Business and Sustainable Development Commission (BSDC), achieving the SDGs will open up $12 trillion of business opportunities in food and agriculture, cities, energy and materials, and health and well-being.[28] But as UNEP FI concludes:

> *"(...) private finance is constrained by risk and return requirements, while public finance is in scarce supply. If the resulting financing gap remains unresolved, investment needs will grow over*

time because of a cumulative effect. Should we conclude that the SDGs are beyond reach? Or could business models be rethought in ways that would increase SDG serving financial flows, but also make them less risky?"[29]

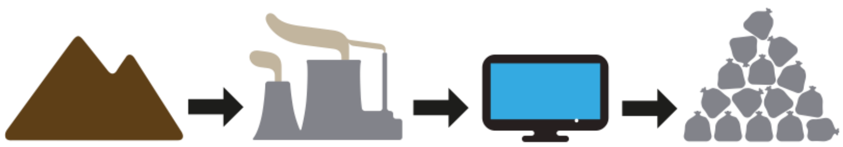
The next section will explore the need to align tax policy with the SDGs and shift financial incentives towards sustainable and inclusive business models. In recent years, corporate income taxes have been in the public eye. This study focuses on two other types of taxes that are less publicised but directly related to today's socio-economic challenges: labour taxes (including social contributions) and environmental (or 'green') taxes.

1.2 The 'polluter pays' principles are not applied

The linear economy

Today's linear 'take-make-waste' industrial model is based on the extraction of natural resources, which are used to create products that become waste after a short lifespan (see Figure 2). This growth model has brought wealth and prosperity, but still leaves many in poverty. Also, the negative side-effects of the model are becoming clear: climate disruption, waste, pollution, loss of biodiversity and scarcity of resources. These impacts are harmful for people, nature and economies worldwide, as waste and pollution are piling up. Every minute, for example, a truck load of textiles is landfilled or incinerated and every second, a truck load of plastics is dumped in the oceans.[30] Between 400,000 and one million people die each year in developing countries because of diseases related to mismanaged waste. At the upper end that is one person every 30 seconds.[31]

Figure 2: The linear 'take-make-waste' economy



External costs

The costs of environmental challenges, such as climate disruption and pollution, are immense. The Lancet Commission, for example, estimates global welfare losses from pollution at $4.6 trillion a year, or 6.2 percent of global economic output.[32] The long-term negative impacts on the global economy caused by carbon emissions in 2017 alone were $16 trillion.[33] In practice, such costs are 'externalised', meaning that they are passed on to society, individuals and future generations, rather than absorbed by the polluter. In recent years, many studies have quantified external costs (or 'negative externalities'). A few examples are provided in Box 3.

Box 3: External costs studies

Plastics. The economic costs (e.g. revenue losses to fisheries, aquaculture, and marine tourism industries) associated with ocean-based consumer plastic pollution amounts to $13 billion per year. (UNEP 2014).[34]

Air pollution. Taking into account only premature deaths, air pollution costs the world economy $5 trillion in welfare losses. The losses are greatest in East Asia and the Pacific, where they amount to 7.5% of GDP, and South Asia, at 7.4% of GDP. (World Bank and Institute for Health Metrics and Evaluation, 2016)[35]

Climate disruption. Southern Asia and Western Africa will be most affected by rising temperatures, with productivity losses equivalent to 4.8% and 4.6%, corresponding to around 40 million and 9 million full-time jobs, respectively. (ILO 2018) [36]

Impacts on businesses. Government inaction on climate change will exacerbate costs and risks, to the tune of $1.2 trillion for 30,000 of the largest listed companies. (UNEP FI 2019)[37]

Considering issues like climate disruption, water scarcity and geopolitical tensions over fuels and materials, it would be rational to put a price on pollution and resource use.[38] Pollution and resource use, however, tend to be relatively tax-free, or even subsidised, as will be addressed next.

Environmental/green taxes

The OECD identifies environmental taxes as taxes on energy, transport, pollution and resources.[39] Throughout this paper, 'green taxes' will refer to all tax measures that put a price on the use of a natural resource. Green taxes are considered growth-friendly, as they are less distortive to the economy than taxes on labour and income.[40] The administrative costs and transaction costs of green taxes are lower than other taxes (notably income taxes).[41] Environmental taxes tend to be much easier to collect than many other taxes, especially direct income taxes. Also, environmental taxes can be levied on a small number of taxpayers, especially upstream taxes on fossil fuel extraction or import. Reducing the number of taxpayers can reduce the overall costs of compliance of the tax system.[42]

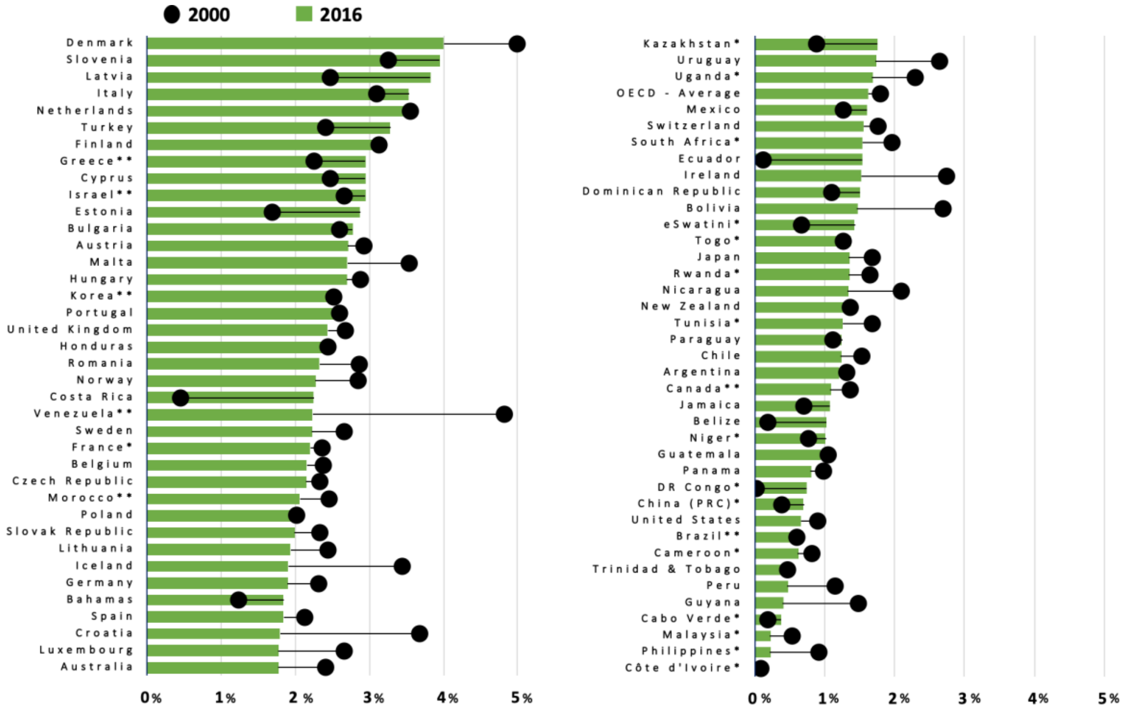
Taxation vs regulation

Unlike emission trading systems or other regulation, green taxes provide more opportunity for recycling the revenues through reducing other taxes to compensate for any welfare loss that may occur. If effectively implemented, cap-and-trade systems can provide greater certainty on environmental outcomes, but green taxes avoid fluctuations in price and provide consumers and businesses with greater certainty on investment decisions.[43] Green taxes are also more economically efficient than direct regulation. MIT's *Global Change* programme found that higher gas taxes are at least 6 to 14 times more cost-effective than stricter fuel standards at reducing gasoline consumption.[44]

Green tax use limited and on declining trend

Despite their benefits, the use of green taxes is limited and on a declining trend. Among OECD countries, environmental tax revenues grew in revenues between 2000 and 2016 (from $471 billion to $742 billion) but declined as a share of total tax revenues (from 5.8% to 5.3%) and as a share of GDP (from 1.8% to 1.6%). Environmental tax as a share of GDP declined in 62% of the countries in the OECD database over the 2000-2016 period (see Figure 3).[45]

Figure 3: Environmental tax as a % of GDP (2000-2016)



**2015, **2014. Source: OECD (Accessed May 2019), Global Revenue Statistics Database.*

Low green tax revenues around the world

Green tax revenues are low around the world. In Canada, for example, environmental taxes raise 3.5 percent of total tax revenues, in the United States 2.6 percent, and in Brazil 2 percent. Data available from Asian economies also show modest green-tax revenues: 3.6% of total tax revenues in China; 12.7% in India; 4.5% in Japan; 10.6% in Korea; 1.5% in Malaysia; 11.3% in Kazakhstan; and 1.3% in the Philippines for example. In Africa, South Africa raises 5.4% of budget through green taxes, Rwanda 8.0%, and Cameroon 4.1%.[46]

Fossil fuel subsidies $373 billion

Besides levying relatively low tax levels on pollution, almost all nations apply direct and indirect subsidies for environmentally damaging activities.[47] Tax credits – defined as a subsidy by the WTO[48]– are a key route of support for the fossil fuel industry.[49] Support measures are typically provided for fossil fuel consumption and production through lower rates, exemptions, or rebates of VAT and excise taxes.[50] The OECD has identified more than 1,000 individual government policies that support fossil fuel production and consumption.[51] In 2009, G20 and Asia-Pacific Economic Cooperation leaders agreed to phase out inefficient fossil fuel subsidies in the medium term.[52] In 2012 global fossil fuel support measures were worth $617 billion. By 2015 they had gone down, but still amounted to $373 billion. The majority of these measures are tax expenditures.[53]

Fossil fuel subsidies $5.2 trillion when taking into account external costs

IMF researchers recently updated their comprehensive report on global fossil-fuel subsidies. They found that, by the common definition of the term, governments subsidized fossil fuels by $296 billion in 2017. The report adds that there is another kind of subsidy, though, which it calls a *post-tax subsidy*. This subsidy reflects the difference between actual fuel consumer prices and the full societal and environmental costs of a fuel. Burning of fossil fuels, the researchers argue, “releases deadly air pollution, hastens the destruction of the climate, and (sometimes) increases traffic fatalities. And since all of those things kill people, they also depress a country’s tax base.” When taking into account such negative effects, fossil fuel post-tax subsidies are projected as high as $5.2 trillion (6.5 percent of GDP) in 2017.[54]

Fossil fuel subsidies are regressive and distortive

There can be good reasons for governments to make energy more affordable, particularly for the poorest and most vulnerable groups. In practice, however, according to the Asian Development Bank (ADB), fossil fuel subsidies are highly *regressive* as they typically benefit medium- to high-income households, which are bigger energy consumers.[55] The OECD states:

> *“Not only do fossil-fuel subsidies undermine global efforts to mitigate climate change, but they also aggravate local pollution problems, causing further damage to human health and the environment. They represent a considerable strain on public budgets as well, draining scarce fiscal resources that could be put to better use, such as strategic investment in the education, skills, and physical infrastructure that people value most in the 21st century. Last, fossil-fuel subsidies distort the costs and prices that inform the decisions of many producers, investors, and consumers, thereby perpetuating older technologies and energy-intensive modes of production.”*[56]

Countries are not sufficiently taxing environmental externalities, as they are “systematically pricing fuels too low.”[57] UN Secretary-General António Guterres says it most clearly:

> *“Fossil fuel subsidies mean using taxpayers' money to boost hurricanes, spread droughts and melt glaciers.”*[58]

Carbon pricing on the rise but prices are low

As of 2019, 57 national and sub-national jurisdictions around the world have implemented or scheduled carbon pricing schemes; 29 have opted for a carbon tax. Governments raised approximately $44 billion in carbon pricing revenues in 2018, with more than half generated by carbon taxes. This is an increase of nearly $11 billion compared to the previous year. Still, the vast majority (80 percent) of all global greenhouse gas emissions are free of charge. About half of the emissions covered by carbon pricing mechanisms are priced at less than $10 per tonne. Only 5 percent of emissions covered under a pricing mechanism are priced at a level consistent with meeting the goals of the Paris Agreement.[59]

The benefits of action

Many studies underline the multiple benefits of effective environmental action. A few examples:

- Restoring the oceans could result in being able to feed a billion people a healthy seafood meal each day.[60]
- Elimination of fossil fuel subsidies would have created global net economic welfare gains of more than $1.3 trillion in 2015. At the same time, air pollution deaths would have been 46 percent lower.[61]
- Bold climate action, including carbon pricing, could yield a direct economic gain of $26 trillion through to 2030.[62]

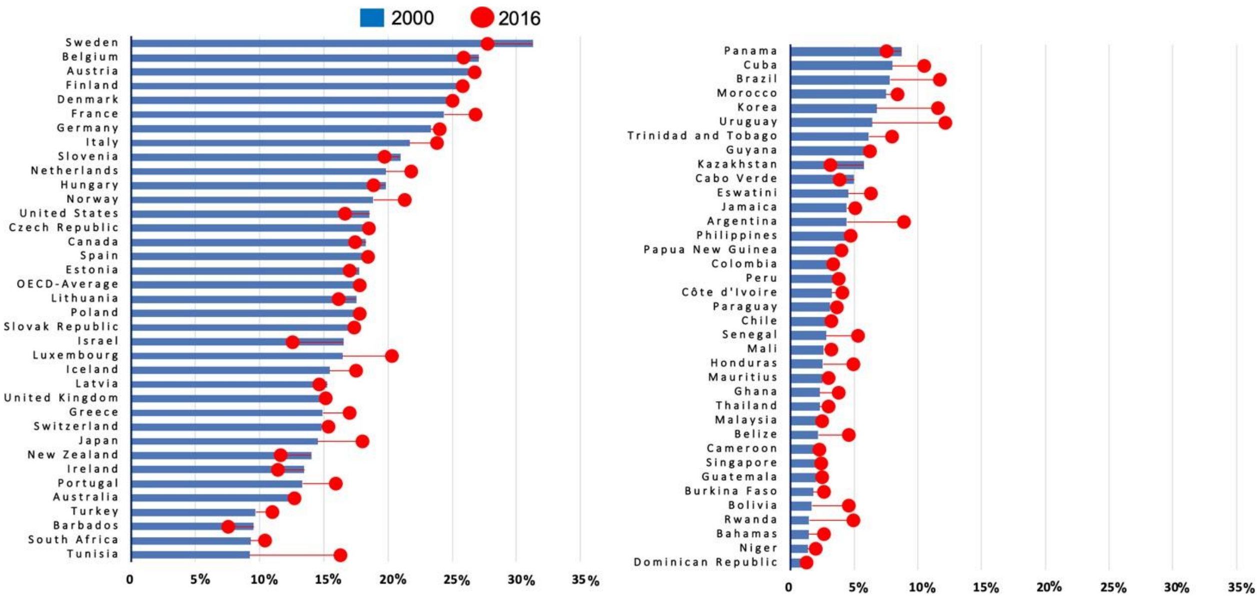
Despite the clear benefits of healthy oceans, clean air, fresh water and, natural resources are structurally overutilized. In our economies, at the same time, human potential is underutilized. Addressing the need for decent jobs will be key in the SDG era. Unfortunately, our tax systems do not support job creation effectively yet, as will be explored in the next sections.

1.3 Labour taxes on the rise

Tax burden on labour high

Consistent with the classification of the European Commission, this study identifies labour taxes including personal income tax, social contributions and payroll taxes.[63] In 2016, in the 36 member countries of the OECD, labour taxes accounted for 51.1 percent of total tax revenues. Such labour taxes are on a rising trend. Labour taxes as a share of GDP increased in 73% of the countries in the OECD database over the 2000-2016 period (see Figure 4).[64]

Figure 4: Labour taxes as a % of GDP (2000-2016)



Source: OECD (Accessed May 2019), Global Revenue Statistics Database. Labour taxes are assumed to consist of the sum of the following line items: (1100) taxes on income of individuals, (2000) social security contributions and (3000) payroll taxes. Costa Rica's earliest available data for PIT: 2003.

Labour tax wedge increased

The *labour tax wedge* is a measure of the tax burden on employment incomes. It is the difference between the employer's cost of hiring a worker and the worker's net disposable income. Between 2009 and 2016, the average labour tax wedge across the OECD increased by 0.7 percentage points, to 36 percent.[65] This means that, on average, of every dollar an employer pays in labour costs, only $0.64 ends up in the pocket of the employee.

Labour versus green tax revenues across continents

In general, while OECD countries rely more on labour taxes, African, Asian, Latin American and Caribbean countries may rely more on taxes on goods and services. Still, labour tax revenues provide significant shares of revenues in these regions, and substantially more than green taxes. In Brazil, labour taxes provide 36 percent of total tax revenues, whereas green taxes raise 2 percent of revenues. In Costa Rica this ratio is 45:10, in Mexico 36:2. Such differences in proportions can also be found in Africa, with South Africa raising 36% on labour and 5% on green taxes. In Rwanda the ratio was 29:8 and in Cameroon 15:4. For Asia, the OECD database includes full data sets for Japan (59:1), Korea (41:11), the Philippines (28:1), Malaysia (15:1), Singapore (17:2) and Kazakhstan (21:11).[66]

Links between labour taxes and employment

Labour taxes have unintended side-effects. Of all taxes, they have the clearest and most direct impact on employment.[67] High taxes on labour income can hamper both job creation and work incentives.[68] Research has demonstrated that a lower tax burden on labour creates employment opportunities.[69] The influence of taxation on employment and unemployment was, for example, significant in a sample of 21 OECD countries. Between 1983 and 2003:

> *"a 10 percentage points reduction of the tax wedge in an average OECD country would reduce equilibrium unemployment by 2.8 percentage points and increase the employment rate by a larger 3.7 percentage points (due to the positive impact on participation)". (Quoted in Dolenc and Laporšek 2010)*[70]

According to the OECD, low-income workers, single parents, second earners and older workers are especially responsive to changes in labour income taxation. The retirement decision of older workers is also highly responsive to tax incentives.[71] In general, both the decision to enter the labour force and the hours worked are affected by labour taxes.[72] Over the years, many researchers and international institutions have called for lower labour taxes to reduce unemployment - see for example (staff) contributions published by the OECD (2018; 2011),[73] World Bank (2015),[74] IMF (2015, 2014),[75] the European Commission (2017, 2013)[76] and the Eurogroup (2014).[77]

Incentives to minimise labour input

For employers, labour taxes increase payroll costs - in addition to net salaries. Such costs tend to encourage employers (both in business and public services such as education and healthcare) to gain efficiency by minimising the number of employees. In general, employers may resort to a number of options to reduce labour input, including:

- Reducing service levels provided to customers (e.g. in hotels,[78] or selling products without additional repair and maintenance services)
- Replacing manual service with machines (e.g. self-checkout lanes in supermarkets[79] and automated assembly lines or 'sewbots').[80]
- Shifting to mass production rather than bespoke, custom-made products (e.g. mass-produced versus hand-made shoes).[81]
- Hiring short-term, informal workers rather than workers on a permanent contract (hiring interns[82] or self-employed persons)[83] or operating in the gig- economy.[84]
- Understaffing (putting pressure on workers to produce more in less time).[85]
- Shifting production to ever-lower income countries.[86]

Automation risks particularly high in South Asia

Cost considerations can also drive the replacement of human roles with automation and artificial intelligence.[87] ILO research found that 137 million workers in South Asia are at a high risk of losing their jobs to automation in the next two decades. Especially garment workers face a high automation risk.[88] This trend makes it even more important to foster inclusive economies in which labour demand is sufficient to enable people whose tasks or jobs are taken over by machines to find new roles.

Human capital in abundance

With roughly 83 million people being added to the world's population every year, the upward trend in population size is expected to continue.[89] This means that there is a growing abundance of human capital (talents and capabilities).

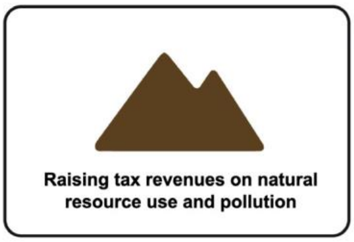
One of the tasks in the SDG era is to accommodate for the full capacity of human potential and provide meaningful employment to a growing world population. Tax could play a significant role. Avoiding a high tax burden on labour while boosting social protection seems to be key. An option for financing such strategy is to increase the tax burden on pollution and resource use. This would enable the 'inclusive circular economy' to grow, as will be discussed next.

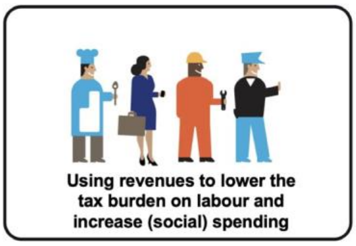
1.4 Updating tax systems to support the inclusive circular economy

Tax reform principles

As mentioned before, many tax systems increasingly penalize human input while incentivizing the depletion of resources. Environmental Tax Reform (ETR) (also known as Green Tax Reform (GTR), Value Extracted Tax, or 'Ex'tax') is the proposal to shift financial incentives, by putting a price on natural resource use and pollution and using the revenues to lower the tax burden on labour and increase (social) spending (see Figure 5). Since both ETR and GTR put emphasis on environmental rather than social impact, the broader term 'tax reform' will be used throughout this document.[90]

Figure 5: Value Extracted Tax (Ex'tax) principles





Support for tax reform

Over the years, many researchers and international organisations have called for tax reform - see for example (staff) discussion papers published by the IMF (2016; 2015; 2012),[91] ILO (2018, 2012, 2009),[92] and World Bank (2015)[93] as well as IPCC (2018),[94] OECD (2018; 2015; 2013),[95] the European Parliament (2015; 2013; 2012)[96] and the European Commission (2018; 2017; 2016; 2015).[97] A selection of quotes is provided in Box 4. Business groups such as WBCSD,[98] the Ellen MacArthur Foundation[99] and the BSDC[100] have also supported tax reform. According to the European Commission,[101] a shift from labour to green taxes is 'a winning strategy' and United Nations Secretary-General António Guterres has stated most clearly:

> *"First, let's shift taxes from salaries to carbon. We should tax pollution, not people. Second, stop subsidizing fossil fuels."*[102]

Box 4: Support for shifting from labour to green taxes

"offsetting increased carbon prices with lower labour taxes can potentially decrease labour costs (without affecting salaries), enhance employment and reduce the attractiveness of informal economic activity)." - **IPCC 2018**[103]

"Increased or more effective use of environmentally related taxes can drive growth-oriented reform by shifting the tax burden away from more distortive taxes, e.g. on corporate or personal income, and contribute to fiscal consolidation–" - **OECD 2015**[104]

"taxing 'bads' (pollutants) rather than 'goods' (labor, capital) can allow for a less costly tax system (...). Revenues can also be used to reduce the social charges imposed on labor costs. This may reduce unemployment rates and help increase real wages." **- High-Level Commission on Carbon Prices, led by Nobel Laureate Joseph Stiglitz and Lord Nicholas Stern 2017**[105]

More statements in support of tax reform are available at www.ex-tax.com.

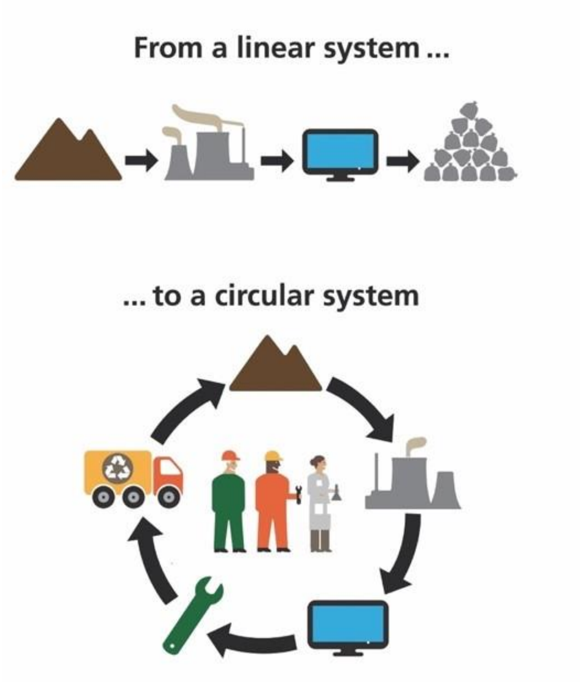
From a linear to a circular economy

In recent years, the concept of the 'circular economy' has gained traction and governments and institutions are adopting circular economy goals, which will likely boost the need for tax reform. A circular economy entails a shift from today's linear industrial model to a carbon-neutral and regenerative model in which products are 'made to be made again'. The Ellen MacArthur Foundation defines a circular economy as follows:

> *"an industrial system that is restorative or regenerative by intention and design. It replaces the "end-of-life" concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models".*

In this way, finite resources and materials are not wasted, and businesses can add value over and over again by applying business models such as repair and maintenance services, recycling, refurbishment and remanufacturing (as illustrated by Figure 6). The circular economy is now an official goal of the 28 countries of the European Union[106] as well as the governments of China,[107] Germany,[108] France,[109] Scotland,[110] Slovenia,[111] Portugal, [112] Italy, [113] Finland[114] and Greece.[115] The Netherlands aims for a 50 percent reduction in the use of primary raw materials (minerals, fossil and metals) by 2030 and a fully circular economy by 2050.[116] Several of these national and regional plans specifically refer to tax reform as a means to achieve a circular economy.[117]

Figure 6: Shifting from a linear to a circular economy



A circular economy is inclusive by design

There is a strong link between labour taxes and the circular economy, as the development of sustainable products and services requires more time, effort, craftsmanship and R&D than linear, mass-produced goods. A World Bank study, for example, showed that clean energy (energy efficiency and renewable energy) creates three times as many jobs as oil and natural gas per million dollars of spending.[118] ILO researchers project that under a circular economy scenario, worldwide employment would grow by 0.1 per cent by 2030 in comparison with a business-as-usual scenario.[119] A circular economy is therefore as much about people and their livelihoods as it is about resource use, emissions and waste.

Climate risks to business $1 trillion

Business leaders have become increasingly aware of the risks of the environmental megatrends. It is now clear that companies that use fewer resources and cause less pollution will in future be less vulnerable to resource supply risks. A recent report by CDP revealed that 215 of the biggest global companies have valued the climate risks to their businesses at almost $1 trillion - with many likely to hit within the next 5 years.[120] The Financial Stability Board's TCFD has stated:

> *"Companies that invest in activities that are susceptible to climate-related risks may be less resilient to the transition to a lower-carbon economy"*[121]

The role of business has changed

The role of business has changed significantly in the debate around carbon and the climate crisis, with businesses actively supporting the Paris Climate Agreement. In 2015, companies and investors with over $11 trillion in assets signed the *Paris Pledge for Action*. Another example is the *We Are Still In Coalition,* whose members represent over $9.4 trillion and comprises more than 3,500 cities, states, businesses and institutions that are working towards the U.S. targets under the Paris Climate Agreement.[122] And by September 2019, a record 515 institutional investors managing $35 trillion in assets had signed a call to governments to 'put a meaningful price on carbon' and 'end government subsidies for fossil fuels'.[123]

Internal carbon pricing

In IEA's *World Energy Outlook*, carbon prices will reach $75–$100 per tonne of CO_2 by 2030, in a scenario consistent with meeting Paris Climate Agreement goals.[124] Many business leaders are acting in anticipation of carbon policies, which they believe are inevitable. In 2017, almost 1,400 companies factored an internal 'shadow price' on carbon into their business plans, representing an eight-fold leap over four years.[125] Unilever, for example, has been internally pricing carbon emissions since 2016, creating a fund of €50 million a year to reinvest in clean technology.[126] Applying such pricing has proven to shift investment decisions toward low-carbon options as they become more competitive than polluting options.[127] Most attention goes out globally towards carbon pricing, but more than 50 companies, including Colgate Palmolive Company and Diageo Plc, have established internal water pricing.[128]

Evolution of business models

Driven by the risks of megatrends and driven by the opportunities of new technologies, new business models are emerging in every sector. Table 1 provides a selection of examples. Companies shift activities from classic linear business models towards urban mining (e.g. Teck and GemChina), towards reuse (e.g. Maersk, Adidas, BMW), towards resale models (e.g. H&M, Ikea, Ycloset) and towards clean energy (e.g. Vattenfall, Shell, Total, BP, Apple). In the apparel industry, for example, H&M has committed to use 100 percent recycled or sustainably sourced materials by 2030[129] and Kering aims to reduce its impact across its supply chain by 40 percent by 2025.[130] IKEA has announced its goal of being a fully circular business by 2030.[131] This means IKEA products will be moving in a 'loop' rather than in a line that ends in landfill or an incinerator.

Table 1: Examples of business model innovation by sector

Food sector

Nescafé has planted 2 million native shade-providing trees within and around coffee farms to protect soil against erosion and improve soil fertility and water retention while offering opportunities for income diversification to the farmers, through the sale of timber and fruit.[132]
Heineken has built circular brewery in Mexico where every piece of waste is repurposed or recycled.[133]
Tyson Foods Inc., the largest U.S. meat producer, is moving into the vegetarian protein business.[134]

Energy

Total invests $300 million to install solar capacity at 5,000 gas stations around the world.[135]
BP and Dupont have developed a second-generation biofuel.[136]
Vattenfall is building the first offshore wind farm without subsidies.[137]
Tata Power Solar commissions the world's largest rooftop solar array.[138]

Metals & mining

Teck recovers materials from e-waste[139]
Tata Steel has developed technology that reduces CO_2 emissions in the steelmaking process by 50%.[140]
SSAB, LKAB and Vattenfall are building a testing facility for steel using hydrogen.[141]
GemChina collects and recycles materials from discarded batteries.[142]
ArcelorMittal steel plant pilot scheme converts harmful by-products into renewable energy.[143]
Goldcorp and Sandvik convert a mine into an all-electric operation, which improves air quality, reduces noise pollution, and eliminates negative health effects that diesel drills have on miners.[144]
Glencore has announced to cap its coal production at current levels after coming under pressure from investors.[145]

Apparel

Levi's makes clothes from hemp and recycled jeans.[146]
Adidas sold 1 million shoes made out of ocean plastic in 2017[147] and develops a running shoe that will be collected and repurposed from consumers.[148]
North Face is cutting waste by selling refurbished coats.[149]
Reebok trainers are comprised of a bio-based sole made from a corn-based plastic substitute, the insole is made from castor bean oil, the fabrics are undyed, and the packaging is made from recycled materials.[150]
Ralph Lauren produces shirts made of plastic bottles and dyed through a process that uses zero water.[151]
H&M sells second-hand clothes.[152]
YCloset offers an online clothing subscription service in China.[153]

Other consumer goods

IKEA is renting furniture, is replacing the use of polystyrene with biodegradable packaging made of mushrooms,[154] and offers solar panel purchase and installation services.[155]
Interface turns discarded fishing nets into carpet tiles.[156]
Carlsberg glues beer cans together to abandon plastic rings.[157]
Unilever launched an education campaign to help consumers save water in Brazil during the country's water shortage. The brand grew at nearly double the market rate.[158]
11 brands (Amcor, Ecover, Evian, L'Oréal, Mars, M&S, PepsiCo, The Coca-Cola Company, Unilever, Walmart and Werner & Mertz) are working towards using 100% reusable, recyclable or compostable packaging by 2025. Together this represents more than 6 million tonnes of plastic packaging per year.[159]
Apple global facilities – retail stores, offices, data centres and co-located facilities in 43 countries, including the U.S., China and India – powered with 100% clean energy.[160]

Transport & logistics

Deutsche Post/DHL is deploying electric vehicles.[161]
Central Japan Railway Company (JR Central) high speed train has a market share of 86% versus 14% for the airplane between Tokyo and Osaka (515 kilometres).[162]
Maersk Line has developed a Cradle to Cradle Passport for ships, creating a detailed inventory that can be used for identifying and recycling the components.[163]
United Airlines will be using biofuel -produced from household trash- to power some of their flights.[164]
SkySails produces large kite-like sails that attach to bulk carrier ships, which can save 30 tonnes of CO_2 per day.[165]
Qantas has trialled the world's first flight ever to produce no landfill waste as the airline embarks on a mission to cut out the use of 100 million plastic items from its planes.[166]

Vehicles

Daimler aims to have 50 all-electric test trucks on roads by end of 2019.[167]
Ford is to invest $4.5 billion in electric cars.[168]
BMW/Mini offers car-sharing services reusing batteries for flexible storage of renewable energy.[169]
Volvo has built electric refuse truck model which can carry a gross weight of 27 metric tons.[170]
Porsche has introduced its first fully electric sports car.[171]

Various

Italcementi has developed a special mix for porous and pervious pavements, roads, walkways and parking lots, specialised for rain and storm water management.[172]
Lafarge has developed cement with a 25–30% smaller carbon footprint.[173]
AkzoNobel Eco Premium Solutions – products that have a significant, measurable sustainability benefit over the competition – account for 19% of sales.[174]
ABN AMRO bank has committed to financing €1 billion in circular assets by 2020.[175]
Credit Suisse Group, ING Bank, FMO and UNDP-UN Social Fund jointly provide funding for the circular economy, sustainable energy and social impact in Asia.[176]
Philips aims to deliver 15% of total revenues from circular solutions and take back and repurpose all the large medical systems by 2020.[177]
Johnson & Johnson, Procter & Gamble, Goldman Sachs, Nike, Starbucks, Salesforce, Steelcase, Voya Financial and Walmart commit to sourcing 100% renewable electricity.[178]

Levelling the playing field

The business models mentioned above are generally more resource-efficient than 'business as usual' models, but at the same time, they require more R&D and human input, to organise take-back systems for products, new supply-chain management and improved service models. Such sustainable business models currently need to compete with activities that require tax-free pollution in order to be competitive. Therefore, in principle, applying the 'polluter pays' principles will level the playing field; what may be a disadvantage to a polluter may mean an advantage to cleaner and innovative solutions.

Tax reform is a potential tool to 'future-proof' economies. The risks and opportunities of tax reform are not evenly distributed, though, and depend on the details of implementation. The next section will look more closely at options in the implementation process and the impacts of tax reform.

1.5 Frequently asked questions

This section will briefly discuss some of the most frequently asked questions on tax reform. How does tax reform work? What are the impacts for the economy? Has it ever been put in practice? And does tax reform increase inequality?

1.5.1 How does tax reform work?

A step-by step approach

Simply put, tax reform requires the following steps:

Step 1: Assessing the pathway necessary to achieve national, regional and global ambitions.

Step 2: Putting a price on pollution and natural resource use.

Step 3: Using the revenues to lower the tax burden on labour, improve social protection (in particular addressing the needs of lower-income households) and increase public investments.

Step 4: Monitoring and adjusting policy measures over time.

During the process, engaging with businesses and the public ahead of any change and communicating the impacts in a transparent manner will be key.

Wide range of policy options

In practice, each country faces a unique set of circumstances and the 'low-hanging fruits' in terms of tax reform differ per country. The Policy Toolkit below was developed by The Ex'tax Project to assess potential options to raise revenues (Figure 7) and use revenues (Figure 8).

- Figure 7 provides more than a hundred tax base options available to governments to apply the 'polluter pays' principles and raise revenues based on natural resource use and consumption (e.g. air pollution, energy, fossil fuels, metals and minerals).[179] Each category includes several sub-categories. For example, pricing schemes could be focused on different types of air pollution, such as carbon, particulate matter and/or nitrogen oxides.
- Figure 8 shows policy options to use tax revenues for the benefit of society (e.g. investments, social assistance and environmental protection). Each category includes several sub-categories. Investments, for example could, amongst others, be directed towards infrastructure, R&D, renewable energy, housing or coastal protection.

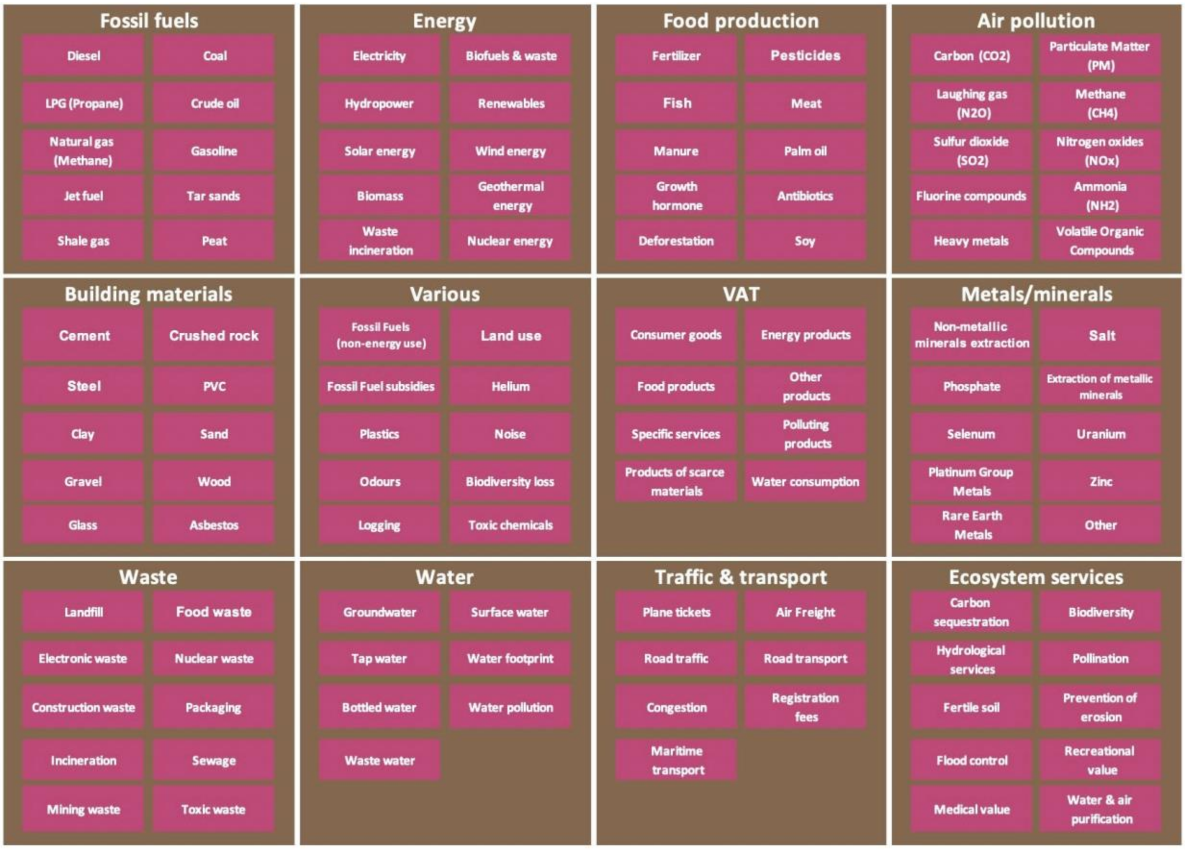
Beyond carbon pricing

In international research, most attention goes out to carbon pricing. It is important to keep in mind, though, that carbon emissions, water and materials usage are strongly interconnected. According to the OECD, half of carbon emissions are related to resource management.[180] The Toolkit therefore keeps a broad perspective. Also, a common argument against carbon taxes is that the tax drives carbon emissions down, and therefore, erodes its own tax base, so that there is less and less to tax. This challenge can be solved by increasing rates progressively according to a pre-announced schedule and expanding the tax bases. The Toolkit illustrates that governments have plenty of options to raise revenues, and to make up for any potential eroding tax base.

Climate damages payments

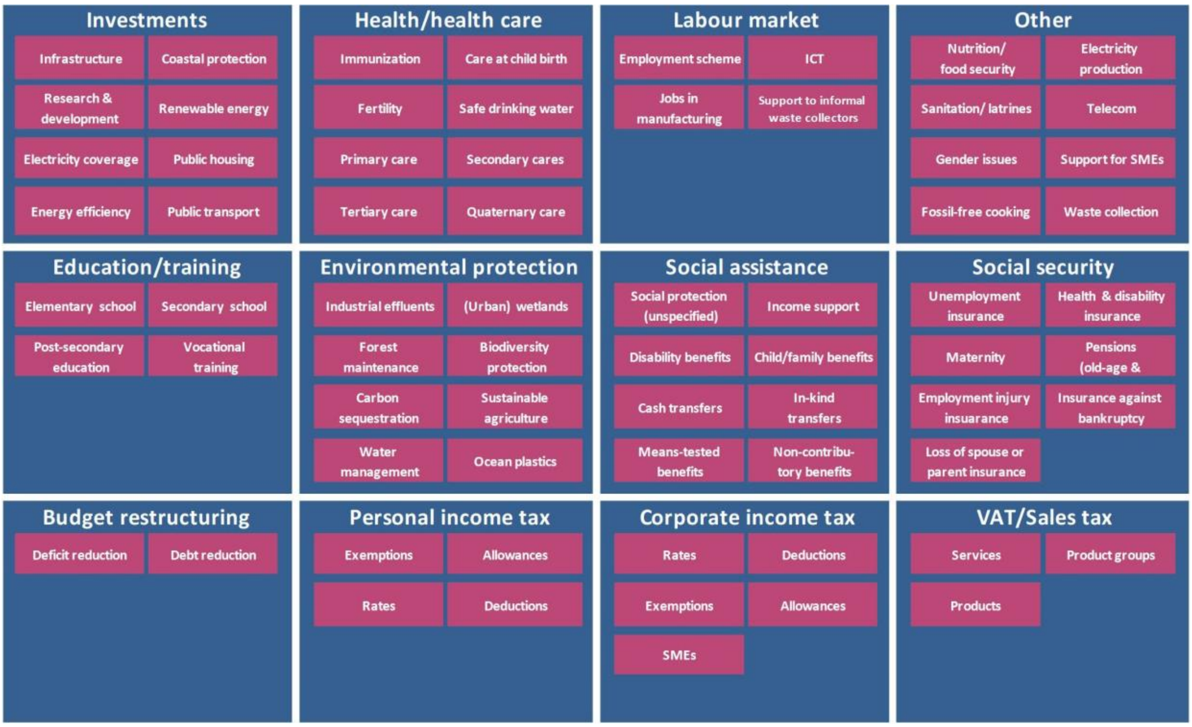
It is important to note, that in addition to putting a price on pollution and resource use in national systems, there is a global dimension that needs to be addressed, since many poor countries are being significantly harmed by the impacts arising from wealthy countries' carbon emissions.[181] Some form of climate damages payments will be needed to raise funding for adaptation measures in low-income countries.[182]

Figure 7: The Ex'tax Toolkit – Raising Revenues



Source: Adaptation from The Ex'tax Project, Deloitte, EY, KPMG, Meijburg and PwC (2016), New Era. New plan. Europe. A Fiscal Strategy for an Inclusive, Circular Economy.

Figure 8: The Ex'tax Toolkit – Use of Revenues



Source: Adaptation from The Ex'tax Project, Deloitte, EY, KPMG, Meijburg and PwC (2016), New Era. New plan. Europe. A Fiscal Strategy for an Inclusive, Circular Economy.

1.5.2 What are the impacts of tax reform for the economy?

Theoretical debate

The foundations of modern tax systems were laid down in the era of the industrial revolution; before globalisation and mass consumption, before the emergence of climate disruption and water supply risks, and before digitisation and automation. Economies and societies have now become highly complex and interconnected. Because of this complexity, modelling the impacts of multiple policy measures is not easy. Since the 1990s there has been much discussion among economists around the different theories and methods used to assess the economy-wide effects of tax reform. The discussion revolves around the question under which circumstances tax reform could contribute to environmental, economic and employment benefits. Studies tend to focus on a variety of countries and use different models, scenarios and assumptions, which makes it difficult to compare the outcomes.[183] Over the years, a large body of research has emerged, though, showing that the costs of inaction are higher (see sections 1.1 and 1.2), and that carefully designed tax reform can actually have multiple benefits.[184]

The many 'dividends' of tax reform

Pigato (2019), published by the World Bank, provides an extensive overview of the considerable benefits of tax reform found in the literature, and summarizes that tax reform can help countries reap a 'triple dividend' of cutting pollution, raising economic activity, and generating and funding public goods and development co-benefits (such as direct improvements in human health). Green taxes, for example, tend to be much easier to collect than many other taxes, especially direct income taxes; therefore, shifting from income taxes to green taxes can reduce the costs of tax evasion. Also, green taxes can be levied on a small number of taxpayers, especially upstream taxes on fossil fuel extraction or import. Reducing the number of taxpayers can reduce the overall costs of compliance of the tax system. Given such considerable benefits, tax reform should be an integral part of all modern fiscal systems, the report states.[185]

Tax reform particularly desirable in developing countries

Tax reform is considered particularly desirable in developing countries, as the benefits reflect several features that are common in developing countries, including:

> *"(i) large informal sectors, which create opportunities to increase employment and output by using ETR revenues to reduce formal-sector taxes; (ii) inefficient tax systems, which create opportunities for ETR to reduce tax distortions, broaden the tax base, and tax rents rather than profits; and (iii) low levels of domestic taxation, which create opportunities for ETR to mobilize domestic resources to fund growth-enhancing public investment. These factors make it likely that ETR will raise measures of economic activity (for example, output and employment) more in developing countries than in developed countries."*

Development co-benefits tend to be particularly large in developing countries:

> *"By discouraging pollution-intensive activities, environmental taxation can promote improvements in air quality and public health, alleviate costly traffic congestion, and reduce the frequency of road accidents. (…) Meanwhile, the revenue from environmental taxes can help the economy to adapt to climate change and fund increased spending on education, infrastructure, social services, and other public goods."*

As a result, co-benefits alone may justify the use of tax reform in developing countries, even before the benefit of climate mitigation is considered.[186]

Impacts on competitiveness

Contrary to popular belief, existing literature (mainly focused on high-income countries) has found little evidence of adverse competitiveness effects from tax reform. Any adverse effects tend to be small and concentrated in a few energy-intensive and trade-exposed sectors. If anything, tax reform incentivizes firms to adopt or invent more efficient technologies. Increases in fuel prices faced by firms across 11 upper-middle-income countries in Latin America and Eastern and Central Europe, as well as Indonesia and Mexico are associated with improvements in labor productivity and profitability. Also, competitiveness losses for some types of firms or sectors may be more than offset by gains in others. In addition, there is little empirical evidence of significant carbon leakage (when firms relocate to less regulated markets).[187] The European Emission Trading System (EU ETS) induced about 10 percent carbon emission reductions between 2005 and 2012 but had no negative impact on the economic performance of regulated firms. In fact, the carbon pricing mechanism led to an increase in regulated firms' revenues and fixed assets.[188]

1.5.3 Where has tax reform been put in practice?

The most well-known and documented tax reforms have taken place in Europe and in British Colombia:

The case of Europe

In the 1990s and early 2000s, seven European countries took steps to shift the tax burden from labour to energy and transportation. In total, these reforms increased green tax revenues by more than €25 billion annually, for a corresponding decrease in labour taxes. The associated reductions of carbon emissions have been documented in several studies. The burden for specific energy-intensive industries remained modest (1%-2% increase in energy costs) and the tax shifts generally had a positive effect on economic activity, depending on how the revenues from the green taxes were recycled. Also, the reforms caused employment in some of the countries to increase by as much as 0.5 percent.[189]

The case of British Colombia

In 2008, the Canadian province of British Columbia started taxing fossil fuel users, in exchange for business tax cuts and tax credits, personal income tax cuts (targeted at lower income categories), low-income tax credits and reductions in property taxes.[190] The tax credit for low-income households has made the carbon tax progressive.[191] Since then:

> *"the economy has grown by an average of nearly 2 percent a year, despite a big national recession through 2009, outpacing the rest of Canada. The use of gasoline, coal and other carbon-based fuels has dropped 16 percent during the same period, reducing greenhouse gas pollution." (Scientific American 2015)*[192]

Employment in the most carbon-intensive industries fell, but this was more than offset by increases in other industries, and net employment rose 0.74 percent between 2007 and 2013.[193] As of 2019, carbon pricing applies throughout Canada.[194]

Key learnings for implementation

Numerous studies have looked at the prerequisites for successful implementation of -especially- carbon pricing. Recommendations include building public trust and low corruption levels, for example.[195] Developing countries are advised to consider taxing upstream rather than downstream. Upstream fuel taxes tend to entail taxing fewer entities (importing or extracting firms) compared to downstream emissions taxes (such as taxes on the pollution released from individual entities burning the fuel), which minimizes the administrative burden, both for firms and for government bureaucracy.[196] In some countries, avoiding the term 'tax' and instead using the term 'CO2 levy', or 'fee and dividend' could make measure more acceptable to citizens. Overall, there seems to be a consensus that reforms should be introduced gradually, and public acceptance should be built with an information campaign.[197] Drawing on international research, especially in Canada, the *Guide to Communicating Carbon pricing* recommends that "communicators foreground the way that revenues are used and the benefits they generate. For this reason, decisions around revenue use will be critical for how the policy is received."[198] It may be clear that countries will adopt the principles of tax reform only when there is long-term vision, good governance and accountability.

1.5.4 Does tax reform increase inequality?

Progressive tax reform

An often-heard worry is that environmental taxes could increase income inequality: they hit low-income households more, as they pay higher shares of their incomes towards energy-intensive goods. It is possible, however, to prevent taxes from increasing income-inequality if the proceeds are used to benefit the poorest population.[199] Also, against popular belief, fuel and coal taxes can have progressive effects. A meta-analysis of 21 country studies found that taxes on motor fuels were progressive in 10 of the 12 developing countries studied. Overall, concerns about distributional equity and poverty are not strong justifications for maintaining low green taxes. Even in instances where the poorest lose out in relative terms, only a small portion (up to a third) of green revenues is needed to compensate lower-income groups.[200]

Options to alleviate low-income groups

In practice, plenty of policy options are available to alleviate the impacts on households in need. Benefits can take the form of (means-tested) tax credits, exemptions, allowances or deductions. In some countries, cash transfers might ease the transition for the unemployed and those who live in poverty: the right solution will differ from one country to another. If desirable, green taxes can also be made more progressive by applying block tariffs (higher rates for higher use) or a tax-free threshold (e.g. leaving a certain amount of water or energy untaxed). Careful design and implementation can alleviate many, if not all of the concerns about discriminatory effects. Overall, it is important to consider all taxes (and transfer payments) together as a system:

> *"not all taxes need be progressive as long as the overall system is." (Mirrlees 2011)*[201]

Failing to tax externalities is regressive

It is important to note that failing to tax environmental externalities is regressive. Fossil fuel subsidies are highly regressive as they typically benefit medium- to high-income households, which are bigger energy consumers (see section 1.4). Furthermore, a large share of the welfare costs of environmental externalities falls on the poor, including increased mortality and morbidity, depletion of resources,[202] crop failures and loss of income.[203]

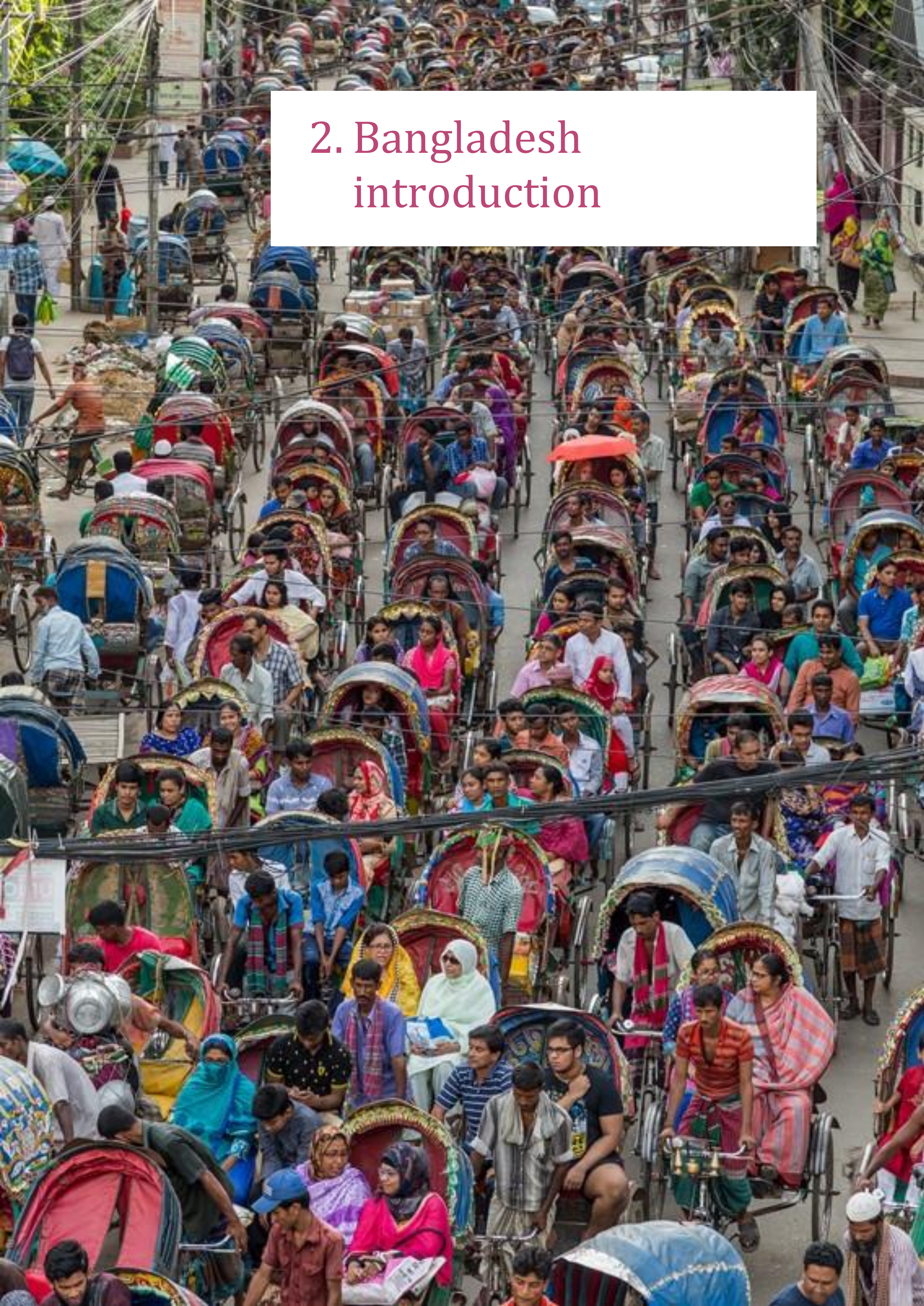
Policies to leapfrog into the SDG era

Leapfrogging is the concept of bypassing intermediate stages of technology through which countries have historically passed during the development process.[204] A well-known example is how some developing countries have skipped the development of landline infrastructure by moving directly to mobile telecommunications.[205] In Bangladesh in 2017, for example, the share of people with a mobile money account jumped from 3% to 21%.[206] In the field of sustainability, similar leaps are made. Between 2012 and 2017, the Chinese city of Shenzhen electrified 16,000 diesel buses.[207]

Leapfrogging is generally associated with technological innovation but could also apply to policy development.[208] Low-income countries often have a low tax take (if not rates) on labour taxes. As experience in higher-income countries shows, and given the high unemployment rates, increasing taxes on labour may not necessarily be the best option to increase revenues sustainably. Taxing the use of natural resources might be a way of leapfrogging tax systems to the SDG era and the development of social protection systems. For example, in 60 out of the 87 countries reviewed by the World Bank, a domestic carbon tax of $30 per tonne of CO_2 would provide the resources to more than double current levels of social assistance in the country.[209]

How would tax reform work in a country like Bangladesh; a country in transition from low-income to middle-income status? A country with a large and growing population and most vulnerable to climate change? The next chapter will explore the extraordinary achievements and challenges of Bangladesh in terms of economic, social and environmental development. This information will serve as the backdrop to the policy scenarios developed in Chapter 3.

2. Bangladesh introduction



Bangladesh has demonstrated remarkable resilience in addressing severe predicaments. The country is still facing multiple challenges, though, including a need for economic development, jobs and social protection, while at the same time effectively addressing the effects of climate disruption, pollution and resource depletion. This section explores why an alignment of taxes with the SDGs is highly topical for Bangladesh.

The following section explores a selection of geographic, socio-economic, environmental and fiscal characteristics of Bangladesh. This is by no means a complete overview, but the selected information will help assess the needs and potential for tax reform.

2.1 Geography, population and climate

A densely populated delta

Bangladesh is a densely populated country in South Asia. It is bordered by India and has a small border with the Republic of the Union of Myanmar (also known as Burma). The major part of Bangladesh lies in the delta of the Ganges, Brahmaputra and Meghna rivers, which spring from the Himalaya mountain range. The rivers deposit their freshwater and sediment in the Ganges-Brahmaputra-Meghna delta, which historically supported high population densities through the provision of ecosystem services including highly productive farming and fishing systems.[210] The aggregate population of Bangladesh increased from 38 million in 1950[211] to almost 165 million in 2017,[212] and is projected to exceed 200 million by 2050.[213] 73 percent of the population live in rural areas.[214]

A tropical monsoon climate

About 80 percent of the country is made up of fertile alluvial lowland. The country is flat with some hills in the northeast and southeast. About seven percent of the total area of Bangladesh is covered with rivers and inland water bodies and the surrounding areas are routinely flooded during the monsoon. Bangladesh has a tropical monsoon climate with four main seasons: 1) the pre-monsoon during March-May, which has the highest temperatures and experiences the maximum intensity of cyclonic storms; 2) the monsoon during June-September, when the bulk of rainfall occurs; 3) the post-monsoon during October-November which, like the pre-monsoon season, is marked by tropical cyclones on the coast; 4) the cool and sunny dry season during December-February.[215]

A disaster-prone county

Bangladesh is one of the most disaster-prone countries in the world. On average, the country experiences severe tropical cyclone every three years, and about 25 percent of the land mass is inundated with flood waters every year. Severe flooding occurs every 4-5 years and covers 60 percent of the land mass.[216] Over the last decade, nearly 700,000 Bangladeshis were displaced on average each year by natural disasters, such as tropical cyclones, storm surges and floods.[217] Two-thirds of the country's land area is less than five meters above sea level.[218]

Most vulnerable to climate disruption

Following devastating cyclones in 1970 and 1991, Bangladesh has made significant efforts to reduce its disaster vulnerability and is now considered a global leader in climate resilience.[219] Despite these efforts, the vulnerability of the population is on the rise due to climate change,[220] which is causing rising (sea) temperatures, heavier rainfall, droughts,[221] salinization of soil and water,[222] intensified cyclones and sea level rises. Bangladesh is widely recognized as one of the countries that is most vulnerable to climate change.[223] According to the Ministry of Environment:

> *"(…) extreme temperatures, erratic rainfall, floods, drought, tropical cyclones, rising sea levels, tidal surges, salinity intrusion and ocean acidification are causing serious negative impacts on the lives and livelihoods of millions of people in Bangladesh, and are gradually offsetting the remarkable socio-economic development gained over the past 30 years"*[224]

Sheikh Hasina, Prime Minister of Bangladesh has stated:

> *"To our utter dismay, without contributing to environmental destruction, we are confronted with a situation where Bangladesh is one of the most climate-vulnerable countries in the world."*[225]
>
> *"The risks are so grave that, for Bangladesh, climate change may displace more than 30 million people by 2050."*[226]

2.2 Socio-economic development

A lower middle-income country

Despite the political turmoil that has characterized its history since independence from Pakistan in 1971, according to the OECD, Bangladesh is a 'competitive economy with ambitions to achieve middle-income country status'.[227] Bangladesh has been a lower middle-income country under World Bank classification since 2015 and has officially started the UN graduation process out of the least developed category towards becoming a developing country in 2024.[228]

High growth rates and development

During the last decade, Bangladesh achieved on average more than 6% economic growth.[229] In 2017, GDP was $250 billion (or $1,517 per capita).[230] More than half of GDP is generated through the services sector.[231] Bangladesh is the world's second-largest exporter of clothing after China[232] and the ready-made garment (RMG) sector represents 80 percent of foreign earnings.[233] Bangladesh has made remarkable progress on key development indicators with poverty falling from 49% in 2000 to 25% in 2015[234] and life expectancy growing from 46 years in 1972 to 72 years in 2011.[235]

Poverty still widespread

Despite the aforementioned progress, one-fourth of the population lives below a poverty line of approximately $29 per month.[236] Income distribution in Bangladesh is very uneven. 53% of national income is owned by the richest 20% of the population. The 40% lowest income groups (representing 40% of the population), have only 13% of total income. More than one-third of children under five are stunted, limiting their ability to grow and learn.[237]

A growing need for decent jobs

The working age population (15-64 years) consists of more than 100 million people.[238] The vast majority of the workforce (87%) is in the informal economy.[239] Almost 40% of Bangladeshis are employed in the agriculture sector, with rice as the single-most-important product.[240] The RMG (ready-made garment) sector is the country's largest employer, employing some four million people.[241] A few striking facts on the labour market (in 2017):

- Mean nominal earnings of employees are $165 per month.[242]
- 56% of employment is 'vulnerable' (according to the ILO definition of own-account workers and contributing family workers who have a lower likelihood of having formal work arrangements).[243]
- 40% of the population is underemployed (working only a few hours a week and at low wages).[244]
- 11% of the *employed* live on less than $1.90 a day.[245]
- There is extensive migration of labour to Saudi Arabia, Kuwait, UAE, Oman, Qatar and Malaysia.[246]
- Overall, 50 per cent of manufacturing workers in Bangladesh work excessively long hours (over 48 hours per week).[247]
- 1.7 million children (5-17 years) are engaged in child labor.[248]

The World Bank has identified job creation as the country's top development priority:

"Bangladesh needs to create more and better jobs for the 2 million youths entering the job market every year. To do so, Bangladesh will need to remove the barriers to higher growth posed by low access to reliable and affordable power, poor transportation infrastructure, limited availability of serviced land, uncertain and complex business regulation, rapid urbanization and vulnerability to climate change and natural disasters, among others."[249]

Electrification success

Bangladesh is considered one of the world's great success stories in access to energy. In 2017, electricity reached some 80 percent of the population, up from 20 percent in 2000.[250] The government target is universal access to electricity by 2021.[251] The estimated cost of rural electrification 2015-2030 are $3 billion.[252] Since 2013, Bangladesh has installed more than 4 million Solar Homes, ensuring the supply of solar electricity to 18 million people who previously used kerosene lamps for lighting purposes.[253]

Business climate

The World Bank's *Ease of Doing Business* survey put Bangladesh at 176th of 190 countries. The ranking is based on 10 areas in the life cycle of a business, including starting a business, getting electricity and credit, paying taxes and trading across borders.[254] The World Economic Forum *Executive Opinion Survey* identified the five highest risks of doing business in Bangladesh being energy price shock, failure of national governance, cyber-attacks, failure of regional and global governance, and unemployment or underemployment.[255] The OECD concludes:

"Bangladesh has made remarkable progress on key development indicators (…). Nonetheless, inequality remains endemic and climate change, population growth and natural disasters continue to constrain progress. Corruption, the weak rule of law and limited transparency contribute to an insecure environment."[256]

Cheap labour for the apparel industry

Bangladesh offers cheap labour for the apparel industry. The legal minimum wage for garment workers in the country is only 8,000 taka ($95) a month. The amount was increased by 51 percent (from $63) in December 2018, but campaigners say workers need at least 16,000 taka ($190).[257] The last time garment workers' salaries were raised was in 2013, after the Rana Plaza disaster, when an industrial building housing several garment factories collapsed, killing more than 1,130 workers.[258] The legal minimum wage in Bangladesh is significantly lower than in other sourcing countries such as China, Vietnam and Cambodia, (where minimum wage are $326, $180 and $182 respectively).[259]

2.3 Environmental issues

Carbon emissions relatively low but rising

Carbon emissions in 2017 were 0.51 tonne of CO_2 per capita in Bangladesh. By comparison, Americans emit 30 times more per person. When ranking counties by their share of global cumulative emissions, Bangladesh ranks 75th out of 226 countries. The main emitters of carbon in Bangladesh are the power sector (42% of total), other industrial combustion (21%), buildings (14%), transport (12%) and 'other' (12%).[260] In the period 2004-2016 the annual average growth rate of carbon emissions was 9.2%.[261]

The costs of climate disruption

Bangladesh is responsible for less than 0.1 percent of total cumulative CO_2 emissions in the world,[262] but the country is bearing the brunt of the devastating effects of climate disruption. The World Bank estimates that the adaptation costs of tropical cyclones and storm surges plus the cost of flooding will be around $6.6 billion by 2030.[263] The Ministry of Environment of Bangladesh estimates the country will need to invest $40 billion from 2015 to 2030 to address the adverse impacts of climate change.[264] The country has two climate change trust funds.[265] The Bangladesh Climate Change Trust Fund (BCCTF), operational since 2010, is the first ever national climate fund established by a least developed country.[266]

Limited use of clean energy

Main energy sources are natural gas (56%), biofuels and waste (25%), whereas renewables such as hydro, geothermal and solar provide less than 0.1 percent.[267] There is one hydropower station, which was installed in 1988.[268] Some 80 percent of households (more than 140 million people) rely primarily on polluting fuels such as biomass for cooking. For lighting, 40 percent of households rely on polluting fuels such as kerosene.[269]

One of the highest incidences of air pollution

In 2017, annual exposures to PM2.5 (particulate matter fine enough to penetrate the lungs and bloodstream) were highest in South Asia. Nepal, India and Bangladesh had the highest exposures.[270] In Bangladesh, the full 100 percent of the population is exposed to levels of air pollution exceeding guideline values set by the World Health Organization (WHO).[271] Bangladeshi would have an expected gain in life expectancy of nearly 1.3 years if they had met the WHO guideline.[272]

Access to water up, but water resources are severely polluted

Bangladesh has made remarkable progress with regard to access to water and sanitation. Between 1990 and 2015, the population experienced a 20-percentage point gain in water access and 29-percentage point gain in sanitation access. [273] The quality of water, however, is poor, as Bangladesh's water resources are heavily contaminated.[274] Access to piped water supply was a mere 12% in 2016.[275] Just 3% of the population is connected to a sewer system[276] and only about half of manufacturing enterprises in Bangladesh have toilets.[277]

Climate crisis puts more pressure on water systems

Climate change is increasing the intensity and frequency of natural disasters that disrupt water and sanitation services. During times of disaster, about a third of households in the country's high-risk areas switch to contaminated, unimproved water sources.[278] In 2002 Bangladesh became the first country in the world to implement a ban on plastic bags, after it was found they played a key role in clogging drainage systems during disastrous flooding.[279]

Industrial effluents

Around 250 industries are discharging chemical pollutants into the Buriganga and Sitalakhya rivers. Every day 4,000 tons of solid waste and 22,000 tons of tannery waste mixes with water in Buriganga river.[280] In 2016, textile industries in Bangladesh generated around 217 million cubic meters of wastewater.[281] By 2021, the garments export target has been set at $50 billion, but the success comes at a huge environmental cost:

> *"The dyeing and finishing plants are the major pollutants of water. Turag that flows by Tongi is almost dead with pollution. Its water looks ink black and gives out such a foul smell (Inam and Refayet, 2017). Wetlands around Dhaka city are being destroyed through land development and dumping of toxic effluents and untreated sewage. Industrial effluents have totally destroyed the ecology of rivers near these large urban areas (Shishir, 2018)."*[282]

Rohingya refugees from Myanmar

In 2017, more than 723,000 Rohingya (a Muslim minority in Myanmar) fled to Bangladesh. The Kutupalong refugee settlement in the Cox Bazar district in Bangladesh has grown to become the largest of its kind in the world, with more than 600,000 people living in an area of just 13 square kilometres. The Bangladesh government has responded generously throughout the latest crisis, straining their already limited resources.[283] In addition to the humanitarian challenges, the influx of refugees has resulted in environmental degradation both within the refugee camp and in the surrounding areas.[284]

2.4 Tax structure

Revenues

Table 2 provides an overview of the central government revenues in Bangladesh in 2016 (the latest year for which such data are available). As explained in section 1.1, tax revenues above 15 percent of a country's GDP are a key ingredient for economic growth and, ultimately, poverty reduction. Bangladesh has one of the lowest tax-to-GDP ratios in the world. In 2016, only ten countries in the World Bank database had a lower tax-to-GDP ratio.[285] In that year, Bangladesh had a tax-revenue gap of $14.9 billion.[286] In 2017-18, tax revenue receipts amounted to $25.5 billion, which was 17.3% higher than the previous year.[287] The tax-to-GDP ratio of Bangladesh has been on the rise, albeit slowly; rising from 8.6% in 2010 to 10.9% in 2017.[288] IMF staff advised Bangladesh:

> *"To boost growth, higher public investment in critical infrastructure and human development is needed and for that purpose it is necessary to improve revenue generation."*[289]

Table 2: Bangladesh Budgetary Central Government Revenues (2016)

	Revenue ($ bln)	% of total revenue
Taxes	**18.0**	**85%**
Taxes on income, profits, and capital gains	5.3	25%
Payable by individuals	1.8	8%
Payable by corporations and other enterprises	3.6	17%
Taxes on payroll and workforce		-
Taxes on property		-
Taxes on goods and services	6.8	32%
General taxes on goods and services	6.5	30%
Excises	0.2	1%
Taxes on international trade and transactions	5.2	25%
Other taxes	0.6	3%
Social contributions	**-**	**-**
Grants from foreign governments	**0.3**	**1%**
Other revenue	**3.0**	**14%**
Total revenues	**21.2**	**100%**

Source: IMF (2018), Government Finance Statistics Yearbook 2017.

Personal income tax

Total personal income taxes are only 1.4 percent of GDP,[290] with less than one percent of the population filing tax returns.[291] Every year, a week-long Income Tax Fair is held across the country, with the aim of increasing the number of income tax payers[292] and November 30 marks Income Tax Day.[293] The National Board of Revenue (NBR) then honours the highest paying citizens (in categories such as: highest paying architect, athlete, lawyer, the highest paying female, the highest paying individual aged under 40, etcetera) and corporations. The highest tax cardholders are entitled to a number of privileges, including priority while reserving seats in public transport and access to VIP lounges at the airports.[294]

Other observations

A few remarkable features of the Bangladeshi budgetary revenues are:

- There is **no concept of social security** in Bangladesh. However, companies of a certain size need to pay 5% of their profits into a Workers Profit Participation Fund. No contribution from employees is required in this case.[295]
- At 1.1% of total tax revenues, **excise duties are relatively low** compared to Pakistan (5%), Bhutan (13%) and India (16%).[296]
- Bangladesh has a **complicated VAT system**. The standard VAT rate is 15% and there are reduced rates of 10%, 7.5%, 6%, 5%, 4.5%, 4%, 3%, 2.25%, 1.5%, and 0%. A VAT rate of 15%, for example, applies to airconditioned restaurant, whereas 7% applies to unairconditioned restaurant.[297]

- Bangladesh is among the countries **receiving a relatively large share of global development aid**:

  "In 2015-16, half of gross bilateral ODA expenditures (…) were directed at 8 countries out of the 48 LDCs [least developed countries]: Afghanistan (USD 3.4 billion), Ethiopia (USD 2.0 billion), the United Republic of Tanzania (USD 1.5 billion), Bangladesh (USD 1.4 billion), South Sudan (USD 1.3 billion), the Democratic Republic of Congo (USD 1.2 billion), Mozambique (USD 1.1 billion) and Uganda (USD 1.0 billion)." (OECD 2018)[298]

Budgetary expenses

Table 3 (below) provides an overview of the use of revenues by the central government. A few striking features from an SDG perspective:

- **Public social expenditure** is around 2% of GDP in Bangladesh, which is the second lowest in the Asia/Pacific region (after Myanmar).
- In Bangladesh, **public spending on education** amounts to less than 2% of GDP (which is half of the average spending across the Asia/Pacific region and the OECD).[299]
- Just 0.1% of the budget is used for **environmental protection**.[300] Note that in general, in South Asian countries, environmental protection expenditures are low (e.g. 0.02% in Pakistan; 0.3% in Bhutan; and 1% in Nepal).[301]

Table 3: Bangladesh Budgetary Central Government Expense by Economic Type (2016)

	Expense ($ bln)	% of total
Compensation of employees	**4.9**	**25%**
Wages and salaries	4.9	25%
Employers' social contributions	-	-
Use of goods and services	**2.7**	**14%**
Consumption of fixed capital	**-**	**-**
Interest	**4.0**	**20%**
Subsidies	**1.4**	**7%**
Grants to other general government units	**3.2**	**17%**
Social benefits	**2**	**10%**
Social security benefits	-	-
Social assistance benefits	0.7	4%
Employment-related social benefits	1.2	6%
Other expense	**1.3**	**7%**
Total expense	**19.5**	**100%**

Source: IMF (2018), Government Finance Statistics Yearbook 2017.

Fiscal ambitions

Bangladesh has high fiscal ambitions, aiming to raise the number of registered taxpayers from 900,000 to 10 million between 2011 and 2023.[302] A number of targets have been set for fiscal year 2020, aiming to increase total revenues, government spending and Foreign Direct Investment (FDI), while maintaining the fiscal deficit.[303] The status of these indicators is included in Table 4.

Table 4: Status of fiscal targets mentioned in the 7th Five Year Plan of Bangladesh

Indicator (% of GDP)	Status FY17-18	Target FY20
Total revenue (% of GDP)	12.2	16.1
Fiscal deficit (% of GDP)	5	5
Government spending (% of GDP)	17.5	21.1
FDI ($ million)	1.583	9,600

Sources: Government of the People's Republic of Bangladesh (December 2015), 7th Five Year Plan. FY2016-FY2020. Accelerating Growth, Empowering Citizens. General Economics Division (GED) Bangladesh Planning Commission; Government of the People's Republic of Bangladesh (December 2018), Bangladesh Economic Review 2018.

2.5 Progress on achieving the SDGs by 2030

Strategies to address the challenges

The *SDG Index and Dashboards* report presents an assessment of countries' distance to achieving the SDGs. In 2018, Bangladesh ranked 111th out of 156 countries.[304] Table 5 provides an overview of some of the formal strategies developed by Bangladesh to address the SDGs.

Table 5: Selection of Bangladesh' national strategies to address SDGs

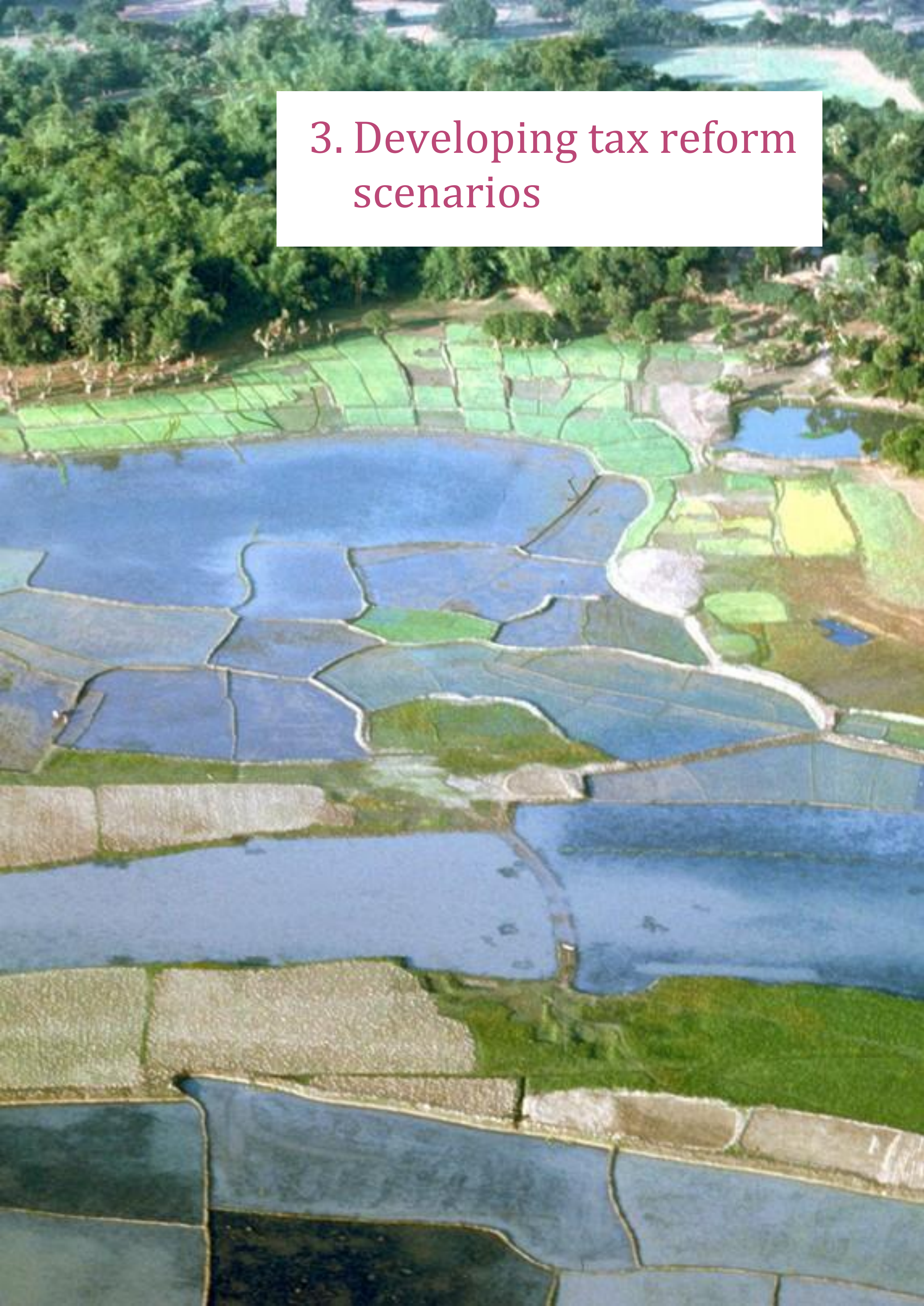
7th Five Year Plan FY2016-FY2020[305] - update under development	Includes specific targets consistent with the scope of the SDGs, with regard to Income and poverty, Sector Development, Macroeconomic Development, Urban Development, Human Resource Development, Water & Sanitation, Energy & Infrastructure, Gender equality, income inequality & social protection, Environmental Sustainability & ICT Development.
Vision 2021[306]	Eight goals that reflect citizens' aspirations with regard to the future of Bangladesh by 2021, when Bangladesh will be celebrating 50 years of independence, including: 1) To become a participatory democracy, 2) To have an efficient, accountable, transparent and decentralised system of governance, 3) To become a poverty-free middle-income country, 4) To have a nation of healthy citizens, 5) To have a skilled and creative human resource, 6) To become a globally integrated regional economic and commercial hub, 7) To be environmentally sustainable and 8) To be a more inclusive and equitable society.
Bangladesh Delta Plan 2100 (BDP 2100)[307]	In view of the long-term challenges presented by climate change and natural hazards, the BDP 2100 seeks to integrate the medium to long term aspirations of Bangladesh. The plan was formulated with the Dutch government and seeks to map out the land-use planning, and disaster management changes needed to meet growing pressures on the delta.
The Bangladesh Second Country Investment Plan (2016-2020) (CIP2)[308]	The overarching goal of the CIP2 is to achieve improved food security and nutrition for all at all times by making food systems nutrition-sensitive and sustainable. It is a tool to mobilise funds and align sectoral and cross-sectoral food and nutrition security related programmes.
Bangladesh Climate Change Strategy and Action Plan (BCCSAP)[309]	Sets out 44 programmes within six strategic areas – food security, social protection and health; comprehensive disaster management; infrastructure; research and knowledge management; mitigation and low carbon development; and capacity building and institutional strengthening.
Intended Nationally Determined Contributions (INDC)[310]	The INDC aims to put forth mitigation actions that Bangladesh can take to tackle its growing emissions and to play its role in global efforts to limit temperature rise to 2°C or preferably 1.5°C above pre-industrial levels. Targets include an unconditional GHG emissions reduction of 5 percent compared to business as usual levels by 2030 in the power, transport and industry sectors.
National Social Security Strategy (NSSS) of Bangladesh (2015)[311]	Priority challenges for the medium-term to ensure a more comprehensive social protection system for its population. The NSSS envisions a Bangladesh where poverty and inequality are effectively tackled, growth and employment are efficiently accelerated, and the weak and vulnerable are adequately protected.[312]

The case for tax reform in Bangladesh

Based on the information above, Bangladesh has achieved much but is still facing significant challenges. The country has a large and growing population, which is in need of decent jobs and inclusive economic growth. Air and water pollution have grown to be detrimental for the economy, health and wellbeing. Although climate change is not the fault of the Bangladeshi people, the nation is already paying the price of the global climate crisis and climate disruption is high on the political agenda. As indicated by Ahmed and Chattopadhyay (2018), the case for tax reform in Bangladesh is clear. First, tax reform can help raise public revenues, which is attractive for Bangladesh as it has a very low tax-to-GDP ratio. Second, green taxes can be helpful in improving the environment. Third, fossil fuel subsidy reform can ensure resource efficiency and less pollution. Finally, the revenues mobilised can be a major contributor to public spending in infrastructure, health, education, water supply, environmental protection and social protection to support poverty reduction.[313]

Taking into account the national context, how could a country like Bangladesh align its tax system with the SDGs? What would be the impacts of such alignment on the economy, labour market, inequality and business sectors? The next chapter will develop some ideas on a potential tax reform scenario and its impacts.

3. Developing tax reform scenarios



How could Bangladesh create a tax system that supports the SDGs? Applying the Methodology and Toolkit of The Ex'tax Project, two preliminary scenarios were developed, based on national priorities in Bangladesh, data availability and opportunities for macro-economic modelling.

3.1 The Ex'tax Methodology and Toolkit

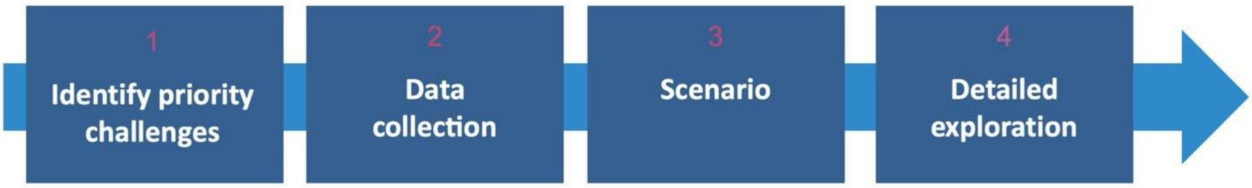
The Ex'tax Methodology

In cooperation with tax experts of Deloitte, EY, KPMG and PwC, The Ex'tax Project has developed a Methodology and Toolkit to help assess country and regional tax reforms.[314] In this study, the step-by-step approach (see Figure 9) was applied to the Bangladeshi context. The first step in the Methodology is to identify priority challenges of the geographic area under review. Secondly, data are collected to explore the economic, social, environmental and fiscal landscape. Thirdly, the Ex'tax Policy Toolkit (see below) is used to create one or more policy scenarios, by:

1. Mapping the range of options available for a specific region to apply the Ex'tax principles;
2. Identifying a focus group of tax bases and
3. Identifying a focus group of policy options.

The final step in the Methodology entails an exploration of the potential impacts of the scenario(s) on the economy, environment, employment and business sectors.

Figure 9: The Ex'tax Methodology



The Ex'tax Toolkit

As mentioned in section 1.5, the Ex'tax Toolkit presents an overview of potential options to raise and use new revenues. **Figure 7: The Ex'tax Toolkit – Raising Revenues** (on page 27) provides policy options to apply the 'polluter pays' principle and raise revenues based on natural resource use and consumption (e.g. on air pollution, energy, fossil fuels, metals and minerals). Each category includes several sub-categories. For example, pricing schemes could be focused on different types of air pollution, such as carbon, particulate matter and/or nitrogen oxides. **Figure 8: The Ex'tax Toolkit – Use of Revenues** (see page 27) shows policy options to use tax revenues for the benefit of society (e.g. for investments, social assistance and environmental protection). Each category includes several sub-categories. Investments, for example could, amongst others, be directed towards infrastructure, R&D, renewable energy, housing or coastal protection.

3.2 Limiting factors

In the selection process of policy options for this analysis, several factors had to be taken into account, including national priorities, data limitations, modelling limitations and the stakeholder and political context. Also, a long-term perspective was taken, which means that the proposals are not aimed to be implemented immediately, but gradually over time.

National priorities

The national priorities of Bangladesh (Step 1 of the Methodology), were mapped based on the 7th Five Year Plan of Bangladesh (FYP) and other national plans (see Table 5 on page 38). The FYP, for example, specifically mentions investments in infrastructure, social protection and electricity coverage.

Using revenues to reduce the deficit or to lower personal income tax levels, for example, is not among the priorities.

Data limitations

In Step 2 of the Methodology, a large number of sources were consulted, including but not limited to databases of the Government of Bangladesh, the OECD, IEA, the IMF and the World Bank. A selection of the identified data is provided in Chapter 2. For modelling purposes, the available datasets provided a number of limitations. Some of the datasets provide recent and detailed information; others do not. For example, detailed data on fossil fuel use, energy consumption, carbon emissions and fertilizer usage are available. Data on other pollutants are limited and data on water usage are available yet outdated.

Modelling limitations

For the purpose of this study, a model (FRAMES: Bangladesh) was developed by Cambridge Econometrics, based on the theoretical framework of the E3ME macro-econometric model (see Chapter 4). Since this newly developed model is not yet as extensive as the original global E3ME model, some potentially desirable policy options could not be included in the scenarios. The ‘business as usual’ (or ‘baseline’) scenario was drawn from established sources such as HSBC and the World Bank. It is important to note that such official prognoses do not include the expected negative impacts of climate disruption on the GDP of Bangladesh (as mentioned in section 2.3). In future, the FRAMES model and its baseline could be adjusted to include such parameters.

Stakeholder and political context

Every country has its own dynamics in politics, culture and sensitivities. Through conversations with several stakeholders, some of the sensitivities could be taken into account. Due to the limited duration of this project, however, only a limited number of consultations could take place.

Medium- to long-term perspective

Putting a price on carbon emissions and abolishing fossil fuels subsidies are the two most documented and most obvious avenues to raise revenues in the SDG era. In countries around the world, such policies are generally met with resistance from corporations that are being subsidized to sustain their polluting activities. In the process of weighing such interests, in essence, the health and wellbeing of the people should be the top priority for governments. The scenarios presented in this study do not claim to be an immediate solution but should be viewed as a medium- to long-term pathway, to assist in the process of balancing the interests of different stakeholders.

Administrative capacities

Every government faces administrative challenges that inhibit the introduction of new policies. The authors are aware of such challenges in Bangladesh. Restraints in capacity have been taken into account as much as possible, but since the scenarios depict a medium- to long-term perspective, a certain development in capacity building can be assumed.

3.3 Two preliminary tax reform scenarios

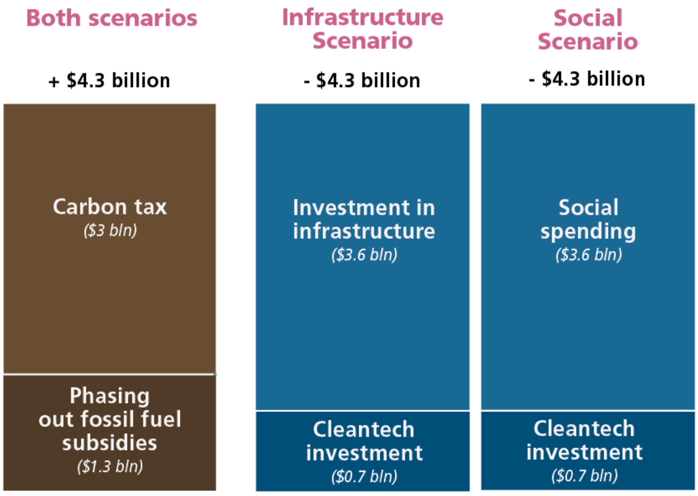
Based on the above analyses and limitations, a few policy measures were chosen to be included in the scenarios under review. Unfortunately, due to data and modelling limitations, more detailed measures, such as pricing of water, fish, timber extraction and industrial water pollution are not yet included.[315] In future research, the number of options in the modelling could be expanded. The two scenarios under review include the following measures:

- Both scenarios raise revenues by introducing a carbon tax for industries and abolishing fossil fuel subsidies to industries.
- The *Infrastructure Scenario* invests the bulk of revenues in infrastructural development, while parts of the revenues are assumed to be invested in clean technology in the textiles sector.

- The *Social Scenario* assumes the bulk of revenues to boost social spending, while parts of the revenues are invested in clean technology in the textiles sector.

Both scenarios are revenue-neutral tax reforms, which means that the revenues from new tax rates introduced are used to offset something else.[316] Figure 10 visualizes the way revenues are raised and used in this study. Please note that of course, in practice, the government of Bangladesh would be able to spend on any combination of cleantech, infrastructure and social spending - or any other use of revenues.

Figure 10: The Infrastructure Scenario and the Social Scenario (in 2025, Bangladesh)



Source: Model projections, Cambridge Econometrics 2019.

In the next sections, the measures under review are discussed in terms of their scope and rationale, their connection with the SDGs and national targets, as well as some international examples.

3.3.1 Raising revenues through a Carbon Tax (for industries)

The measure

Gradual introduction of a carbon tax of $30 per tonne of CO_2 emitted by industries and the power sector. The tax does not apply to transport and household/residential emissions. Such a measure would raise $3.0 billion in revenues in 2025 in each of the scenarios.

Rationale

It's important to note that first and foremost, high-income countries, who are responsible for historic carbon emissions, should lower their carbon emissions and compensate low-income countries for carrying the burden of the climate crisis.[317] However, in the SDG era, each and every economy should prepare for and benefit from carbon neutrality:

> *"Given the magnitude of the warming-induced growth penalties that poor countries have already suffered, expansion of low-carbon energy sources can be expected to provide a substantial secondary development benefit (by curbing future warming-induced growth penalties), in addition to the primary benefits of increased energy access." (Diffenbaugh 2019)*[318]

The Bangladeshi Ministry of Finance has stated that a carbon tax can be levied on the production, import, distribution, or use of fossil fuels. Such a tax increases the costs of carbon-emitting fossil fuels, compared to such non-carbon emitting energy sources as renewable energy and nuclear power.[319] Carbon taxes can be relatively simple to implement:

> *"[Carbon taxes] can be collected using the same administrative systems as existing taxes, or with only small modifications. In addition, when levied "upstream," such as on fuel wholesalers*

(importers and producers), carbon taxes need only be collected from relatively few firms. Wholesalers then pass the tax on to retailers, who pass it on to consumers. This "keep-it-simple" approach is strongly recommended by the experience of other countries." (Davies et al. 2018)[320]

According to these World Bank experts, introducing a carbon tax in Bangladesh could help rebalance the tax system away from workers and toward the payment of taxes on things that cause harm.[321]

World Bank supports carbon tax in Bangladesh

The World Bank has estimated that Bangladesh could raise up to one percent of GDP in tax revenues, at $30 per tonne of CO_2. The potential benefits of a carbon tax for Bangladesh are numerous, according to the World Bank, including:

- Carbon taxes are **easier to collect** than many other types of taxes.
- Carbon taxes can **boost Bangladesh's low revenue** while allowing it to lower other taxes to boost competitiveness.
- Carbon taxes will add to **resources available to adapt to the impacts of climate change**.
- Carbon taxes can help Bangladesh to **meet its commitments under the Paris Agreement** of reducing carbon emissions to 5 percent below the 'business as usual' scenario.
- Carbon taxes can help Bangladeshi firms to **prepare for changing global market** ("pre-empt changes in sentiment in increasingly environmentally aware export markets").
- Carbon taxes are **less susceptible to economic cycles** than most other taxes.[322]

Transport fuels versus other fuels

The main carbon emitters in Bangladesh are the power sector (42% of total), other industrial combustion (21%), buildings (14%), transport (12%) and other (12%).[323] In this study, for a number of reasons, transportation and household mobility are as of yet excluded from carbon taxation. Firstly, alternatives in the form of public transport are not yet readily available for consumers in Bangladesh. Also, in the past, transport tax proposals have been met with resistance. In fiscal year 2014-2015, the National Board of Revenue contemplated the introduction of a carbon tax on private vehicles,[324] which was not followed through. In 2017, a carbon tax proposal was abandoned due to backlash from (amongst others) the transport sector.[325] Another reason to exclude transport and mobility is that recent studies modelled the impact of a carbon tax on petrol and diesel, which is not duplicated here (see Box 5).

Box 5: Carbon tax studies Bangladesh

World Bank: 'Options for a carbon tax in Bangladesh' (2018)

Carbon taxes could be a significant revenue source for the government of Bangladesh, raising up to one percent of GDP, at $30 per tonne of CO_2 equivalent. Simulations show that most revenue would initially come from gas and petroleum products. Households of all wealth levels would pay a similar amount as a share of their income, making the first-round effects of a carbon tax distribution neutral. A carbon tax increases the cost of fuel but only by a small amount. At $5/t$CO_2$, the motor gasoline price could be expected to increase from TK89/litre to TK90/litre. At $30/t$CO_2$, it would increase to an estimated TK94-95/litre. Other fuels would see similarly small increases. However, some sectors would be more affected than others, particularly since some currently receive special treatment, benefiting from cheap fuel. The study provides an excellent overview of challenges, solutions and lessons from other countries' experiences. It concludes: "Given the potential benefits, and its ability to mitigate the risks, Bangladesh should consider implementing a carbon tax".[326]

Ahmed and Khondker: 'Towards a Carbon Tax in Bangladesh' (2018)

This study modelled the impacts of a carbon tax on petrol, octane and diesel, furnace oil and kerosene in Bangladesh, imposing a 10 percent tax on the current prices starting in FY2019 and gradually increasing to 25 percent by FY2041. The main conclusion is that such a tax lowers CO_2 substantially and raises considerable revenues. There are initial small negative output and employment effects that can be offset with fast transition to a clean energy environment. Additionally, the adverse output effects can be compensated with additional public investments in clean energy and infrastructure and social protection spending facilitated by higher revenues from the carbon tax. The report concludes that "a proper combination of fossil fuel pricing, carbon tax and investments can make carbon tax a win-win policy package".[327]

The political context for fossil fuel pricing reform is not easy, and all potential fuels taxes have been politically opposed.[328] The World Bank, however, advices that:

> *"Implementing comprehensive energy sector reform that targets inefficiencies at different stages of power supply and distribution could boost supply while also limiting reliance on imported fossil fuel. This would not only minimize the direct cost of electricity generation, but also help avoid harmful emissions from fossil fuel-based generation."[329]*

It's important to keep in mind that since 2009, the cost of wind turbines has dropped by nearly 33 percent, and that of solar photovoltaic modules by 80 percent, making both technologies increasingly competitive with fossil fuel power generation. Solar energy is now the cheapest generation technology in many parts of the world.[330] Hence, alternatives for energy generation are getting more readily available.

The measure supports multiple priorities

The measure would tie in with the SDGs that mention domestic resource mobilization (1,10,12 and 17) as well as SDG 3 (healthy lives), 7 (energy), 8 (sustainable economic growth), 12 (sustainable consumption and production patterns) and 13 (climate change). Finally, the measure ties in with national priorities to 'Ensure energy mix for energy security' and 'Environmental, Climate Change and disaster risk reduction considerations are integrated into project design, budgetary allocations and implementation process'.[331] It also supports the INDC of Bangladesh (see page 38).

Pricing level

A wide variety of estimates exist of the so-called social cost of carbon (i.e. the damage that results from emitting a tonne of CO_2). The price of $30 per tonne is roughly based on the (€30) minimum pricing level proposed by the OECD, as being "truly a minimum" estimate of climate damages from carbon emissions. In 2018 the OECD added a benchmark of €60 per tonne to their analyses to reflect the estimated cost of carbon in the future.[332] Other estimates do not take into account the external costs to society, but the price range needed to achieve certain reduction targets. The High-level Commission on Carbon Pricing concluded that a $40–$80 range in 2020, rising to $50–$100 by 2030, would be consistent with the core objective of the Paris Agreement of keeping the average temperature rise below 2°C.[333]

International examples

As of 2019, 57 national and sub-national jurisdictions around the world have implemented or scheduled carbon pricing schemes, 29 of which have opted for a carbon tax. 96 Parties - representing 55% of global GHG emissions - have stated in their Nationally Determined Contributions that they are planning or considering the use of carbon pricing to meet their commitments.[334] In Asia, **India** introduced a carbon tax in 2010 as a tax on domestic coal, which was later broadened to include petrol and diesel.[335] **Japan** introduced a carbon tax in 2012.[336] **Singapore** is scheduled to introduce a carbon tax in 2019. The **China** national Emission Trading Scheme (ETS) was launched in 2017 and work is underway to prepare for its implementation. The **Kazakhstan** ETS was restarted in 2018 following a two-year suspension. The **Republic of Korea's** ETS started in 2015.[337]

Carbon taxes in Mexico and South Africa

Mexico has been moving from fossil fuel subsidies to carbon pricing. In 2015, fuel tax receipts accounted for 8% of total tax revenues in 2015 (the third largest tax in terms of revenues in Mexico). In addition, a modest carbon tax raised about 0.3% of total tax revenues.[338] Revenues in Mexico are not earmarked, but flow into the general budget.[339] **South Africa** has recently signed a carbon tax law. Set at $8 per tonne, the tax will be largely offset by allowances to lower it to an effective rate of $0.40-$3 per tonne in the first three years. The tax is set to rise at two percent above inflation until 2022 and in line with inflation afterwards.[340]

Putting a price on the extraction of fossil fuels

Putting a price on the domestic extraction of a fuel (rather than its carbon content) can also be an option to serve development goals, and to a lesser extent, environmental goals. Since the 1960s, the government of the Netherlands has raised almost €417 billion in revenues for the national coffers from the exploitation of oil and gas fields, which has enabled investments in social security and infrastructure.[341] At the same time, the extractive industry benefited from €1 trillion in turnover.[342] Considering the fact that natural gas is a finite resource, and causes pollution, it is important to plan for substitution in time. In the Netherlands, exploitation of the gas fields will come to an end soon, as supplies are running out. Also, the exploitation is causing earthquakes.[343] Norway has invested its fossil fuel extraction revenues in a sovereign wealth fund, which could be looked at as an example for Bangladesh.

3.3.2 Raising revenues through removal of fossil fuel subsidies (for industries)

The measure

Gradual removal of fossil fuel subsidies for industries and the power sector, for natural gas ($1.3 billion in 2025) and oil ($7 million in 2025). The residential and transport sectors are not directly affected. Also, the subsidy for electricity remains unchanged. In total, this would raise $1.3 billion in revenues in 2025 in each of the scenarios.[344]

Rationale

In 2017, Bangladesh imported $4.8 billion worth of petroleum products.[345] That same year, the country provided $1.5 billion worth of fossil fuel subsidies;[346] a quarter of the amount allocated towards social safety programs in the 2017 budget.[347] When taking into account the external costs of burning fossil fuels (including global warming and air pollution), fossil fuel subsidies cost Bangladesh as much as $8.8 billion in 2015.[348] According to the Ministry of Finance of Bangladesh:

> *"Subsidized energy discourages initiatives that might develop better alternatives, for example green energy such as solar power. Renewable energies are relatively more expensive, however, and subsidies for fossil fuels put these alternative energy sources at a further disadvantage, discouraging their adoption."*[349]

Natural gas main recipient of subsidies, supply risks loom

The bulk of fossil fuel subsidies support the use of natural gas. In Bangladesh, natural gas provides 58 percent of total primary energy supply and 80 percent of electricity generation.[350] As of yet, natural gas is domestically sourced. BGR (2015) data for total natural gas resources and reserves show that Bangladesh could meet natural gas demand domestically until at least 2025 (assuming productive capacity can expand to exploit domestic resources). But dependence on imports is expected to rise given Bangladesh’s current natural gas production levels, its natural gas reserves, and its fast-growing economy.[351] Supply risks are already emerging:

> *“Owing to substantial underpricing of natural gas compared to economic cost, natural gas consumption has been highly inefficient and constrained domestic investment in gas extraction. Rapid depletion of natural gas has now led to a severe gas rationing, thereby causing production loses in manufacturing and growing reliance on carbon emitting fuel oil for power production.” (Ahmed 2018)*[352]

Restructuring fuel subsidies would be rational

Even though natural gas subsidy reform is a highly sensitive issue, restructuring fuel subsidies would be rational. As the Ministry of Finance of Bangladesh stated in 2014:

> *"The adverse consequences of subsidy reduction on some segments of the population, (…) could be offset in the longer term by economy-wide benefits such as better fiscal sustainability, increased social spending targeting the poor, more efficient resource allocation, increased investment, and higher growth."*[353]

Research by the Asian Development Bank found that:

> *"over time the new reality of higher-priced fossil fuels spurs users to change behavior and switch to cheaper forms of energy, which encourages investment in clean energy and drives down its cost. In time, the initial exaggerated effects of more expensive fossil fuels are softened as the economy returns to a path of cleaner energy and sustainable fiscal positions."*[354]

And the World Bank supports gradual reform in combination with social assistance:

> *"hikes in gas and electricity prices can cause immediate economic distress, especially for the poor and vulnerable. Raising prices gradually while providing targeted social assistance can mitigate the impact. (…) price reform delivers large economic benefits in the long term".*[355]

The measure supports multiple priorities

The measure ties in with the SDGs that mention domestic resource mobilization (1,10,12 and 17). It also supports SDG 3 (healthy lives), 7 (energy), 8 (sustainable economic growth), 12 (sustainable consumption and production patterns) and 13 (climate change). Finally, the measure ties in with the national priority: 'Ensure energy mix for energy security'.[356]

International examples

In 2009, G20 and Asia-Pacific Economic Cooperation leaders agreed to phase out inefficient fossil fuel subsidies in the medium term. Although implementation has been slow and patchy, several Asian countries have lowered subsidies, including India, Indonesia, Malaysia, the Philippines, Thailand and Vietnam.[357] The IEA and IMF have documented fossil fuel reforms undertaken in almost 30 countries in 2013 and 2014, including:[358]

- **Egypt** raised fuel prices by 78% in 2014 and is doubling electricity prices over a period of five years.
- **Indonesia** raised petrol and diesel prices by an average of 33% in 2013 and by another 34% in 2014.
- **India** eliminated diesel subsidies in 2014 after incremental increases over the preceding two years.
- **Iran** raised petrol prices by 75% in 2015.
- **Malaysia** raised fuel prices by 10–20% in 2013 and again in 2014.
- **Namibia** removed subsidies steadily according to a three-year reform plan.
- A gradual approach was also adopted by **Kenya** (electricity), where the authorities were able to progressively gain support for broader reform by delivering improved services.

Earlier reforms in **Indonesia** and **Ghana** (in 2005) have been successful because of accompanying social policies:

> *"Indonesia's unconditional cash transfer program, which covered 35 percent of the population, was an important component of its successful strategy in overcoming social and political opposition to fuel subsidy reforms. (…) In Ghana, in 2005, the government commissioned an independent poverty and social impact analysis to assess the winners and losers from fuel subsidies and subsidy removal. This was an important foundation for persuasively communicating the necessity for reform and for designing policies to reduce the impact of higher fuel prices on the poor." (European Parliament 2017)*[359]

Areas of concern and solutions to be studied more carefully

The revenue raising measures in sections 3.3.1 and 3.3.2 share a similar purpose and face similar challenges with regard to their impacts. Table 6 below provides some areas of concern and a few potential solutions. These issues are to be studied more carefully.

Table 6: Purpose, areas of concern and potential solution of the revenue-raising measures

Goals	Area of concern	Potential solution
- Creating a level playing field between energy sources (the 'polluter pays' principle). - Aligning tax policy with climate and health goals. - Creating fiscal space to invest in public services. - Incentivizing a shift to clean technologies - Limiting reliance on imported fossil fuels.	- Price increase for industries. - Costs may be passed on to consumers. - Production may shift to other countries (competitive disadvantage).	- Industries can shift to less polluting options. - The measure is introduced gradually and accompanied by social policies. - Additional measures to support investments in low-carbon technologies.

The next sections will take a closer look at the use of revenues in each of the scenarios under review.

3.3.3 Use of revenues: investing in clean technologies

The measure

In each of the scenarios under review, $0.7 billion (20% of the newly raised revenues) in 2025 is allocated to support the Bangladeshi textiles sector in the transition to clean technologies and circular business models. With this measure, negative impacts of price increases in the scenarios are negated. The measures protect the long-term competitiveness of Bangladesh's most important export sector.

Rationale

Governments tend to provide tax exemptions to industries that are vulnerable to global competition, in order to reduce the risk of industries shifting their activities to less-regulated countries. In Bangladesh, for example, a reduced corporate income rate is applicable for the textiles industry (15% compared to 25% for listed and 35% for unlisted and private limited companies).[360] In this study, the risk of outsourcing production is mitigated through innovation policy rather than exemptions. In the modelling, part of the revenues is allocated for cleantech funding targeted towards the textiles industry. Such investments may not neutralize expenses for the industry, but the investments do contribute to future-proofing production methods and mitigating the costs of climate disruption and water scarcity. It is estimated that:

> *"the adoption of resource-efficient and cleaner technologies in the Bangladeshi textile and leather industries could reduce long-term investments and operational expenditures needed to ensure a continued supply of water by up to US$9 billion by 2030". (WRG 2015)[361]*

> *"Gradual adoption of improved technology and cleaner production options could reduce wastewater volume by around 23% by 2021." (Sakamato 2019)[362]*

> *"36 per cent of the industry's climate impacts occur during dyeing and finishing (…). This is because the electricity and heat being used in this stage mostly comes from hard coal and natural gas. If we could substitute these fossil fuel-based energy sources with renewable energy sources we would make a lot of progress." (Schragger n.d.)[363]*

Chinese mills taking effective measures

Investments in clean technologies can be highly effective. In China, for example, five pilot mills tested a series of "easy to implement, low cost, quick return" measures that are profitable and reduce environmental impact. Enabled by smart metering, the average reduction in water use was 9%, with the best mills achieving a 20% reduction. Average energy consumption fell by 6% and in some cases energy reduction was as high as 10%, with total savings equivalent to 61,000 tonnes of coal. Economic benefits totalled $14.7 million.[364]

Types of investments

Cleantech funds could potentially be invested in R&D and technologies to deploy sustainable processes such as waterless dyeing and ultrasound laser cutting.[365] Investments in energy saving solutions and renewable energy could also be included. In addition, funds could enable the development and use of sustainable dyes[366] and new types of materials.[367] Note that if such materials are locally sourced, they could contribute to Bangladesh becoming less dependent on cotton imports. The textiles sector is currently 90 percent dependent on imports.[368]

The measure supports multiple priorities

Depending on the specific use of the funding, the measure ties in with SDGs 6 (sustainable management of water), 7 (sustainable and modern energy), 8 (sustainable economic growth), 11 (safe and sustainable cities), 12 (sustainable consumption and production patterns), 13 (combat climate change), 15 (sustainable use of ecosystems). The measure also ties in with the national priority for 'Spending on Research and Development to constitute 1% of GDP'.[369] Date on current levels of R&D spending have not yet been identified.

3.3.4 Use of revenues: investing in infrastructure

The measure

In the *Infrastructure Scenario,* $3.6 billion (80% of the newly raised revenues) in 2025 is used to invest in infrastructure. The exact infrastructure projects are not defined; the supply side effects of the policy are not modelled.

Rationale

The *Global Competitiveness Report 2018* found that inadequate infrastructure is one of the most problematic factors for doing business in Bangladesh.[370] Infrastructure is one of the core themes set under the 7th Five Year Plan of Bangladesh, with targets such as the construction of bridges, expressways and highways.[371] According to an IMF review:

> *"A planned investment of US$409.0 billion is expected under the Seventh Plan, but the chronic under-implementation of the Annual Development Plan, despite its higher priority and continuing growth with each budget, needs to be addressed. (…) the government needs to raise tax revenues to create the fiscal space to upgrade infrastructure, such as electricity, roads, rails, and ports. This will in turn improve the business environment, attract FDI [Foreign Direct Investment], and diversify exports.*[372]

The World Bank also identifies infrastructure bottlenecks as "a risk for future growth prospects" in Bangladesh.[373]

Foreign investments are not enough

Large infrastructural works are being financed through foreign investments. Under the *Belt and Road Initiative*, the Chinese authorities have planned to finance several infrastructure projects of Bangladesh in sectors like telecom, agriculture, power and energy. A line of credit with India totalling $4.5 billion was signed in 2017.[374] Despite these foreign investments, this measure is included in the scenarios based on the large ambitions of Bangladesh with regard to infrastructure, public utilities, R&D and sustainability.[375] The modelling in this study (see Chapter 4) allows for a comparison of the impacts of investments in infrastructure versus increasing social spending, which will be discussed in section 3.3.5.

Potential role of local solutions

Bangladesh has a strongly developed culture of local, bottom-up initiatives. In practice, therefore, taking a bottom-up, participatory approach rather than taking a top-down planning approach, should be considered.[376] Investments could also, for example, be targeted towards electric transit (including electric buses[377] and electric rickshaws),[378] which could contribute to cleaner air and less traffic congestion. Also, off-grid energy solutions (such as Solshare)[379] and low-carbon agricultural infrastructure (such as digital demand and supply platforms[380] and rooftop gardens[381]) could be among potential investment opportunities.

The measure supports multiple priorities

Depending on the use of revenues, the measure potentially supports SDGs 6 (sustainable management of water and sanitation), 7 (energy), 9 (infrastructure and innovation), 10 (inequality), 11 (sustainable and safe cities), 12 (sustainable consumption and production patterns) and 13 (climate change). An IMF review identified access to clean water, electricity and reliable and affordable transportation also as key enablers to (female) labor force participation and inclusive growth (SDGs 5 (gender equality) and 8 (sustainable and inclusive growth and decent work)).[382]

3.3.5 Use of revenues: increasing social spending

The measure

In the *Social Spending Scenario*, $3.6 billion (80% of the newly raised revenues) in 2025 is used to boost household income. The measure is targeted towards the lowest two income quintiles. The exact nature of the payment is not defined; in the modelling framework it is treated as a basic transfer from government to households. Implementation could take the form the government deems most suitable (including child benefits, cash transfers, social security, in-kind transfers[383] or perhaps employment guarantee schemes which provide a certain number of days of work to low-income groups).[384]

Rationale: shared prosperity for the bottom 40 percent

In the 2017-18 revised budget of Bangladesh, \$6.1 billion (13.1% of the budget, or 2.2% of GDP) was allocated for social safety net programs.[385] The 7th Five Year Plan of Bangladesh includes the goals to 'Reduce or maintain the current income inequality' and 'Spending on Social Protection as a share of GDP to be increased to 2.3% of GDP' by 2021.[386] In the modelling, the additional social spending is targeted towards the bottom 40 percent of the population. The World Bank promotes 'shared prosperity' defined as 'the income growth of the bottom 40 percent of the population'.[387] The OECD *Inclusive Growth Initiative* also puts the emphasis on policies that can improve the perspectives of the bottom 40% of the income distribution.[388] Such approach is in line with SDG 10 (Reduce inequality within and among countries), target 10.1, which reads:

> *"By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average."*

The measure supports multiple priorities

The measure potentially ties in with SDGs 1 (end poverty), 2 (food security), 3 (health), 7 (access to energy), 8 (inclusive economic growth), 10 (reduce inequality) and 11 (inclusive, safe human settlements). As mentioned before, the measure ties in with the national priorities to reduce or maintain the current income inequality, to increase spending on social protection, and to reduce the head-count poverty ratio and extreme poverty. Finally, it ties in with the National Social Security Strategy (NSSS) Priority Challenges to expand coverage of social protection for the extreme/hard-core poor and most vulnerable people of the society, ensuring that the most vulnerable women are provided with income security and expanding coverage to the residents of urban areas and to the socially excluded people.[389]

International example

In Egypt, in 2013, the phase-out of fossil fuel subsidies was inaugurated alongside two cash transfer programs to help offset the impact of fuel price increases on poor and vulnerable households. By 2017, these programs covered about 1.5 million families (6 million Egyptians) out of the 1.7 million families targeted.[390] As mentioned in section 3.3.2, reforms in Indonesia and Ghana (in 2005) have been successful because of accompanying social policies.

Cambridge Econometrics modelled the impacts of the scenarios on tax revenues and macroeconomic and environmental indicators in Bangladesh. The next chapter will describe the results.

4. Modelling results

Cambridge Econometrics has modelled some of the impacts of two preliminary scenarios, which include putting a price on carbon emissions and abolishing fossil fuel subsidies, while using the revenues to invest in clean technologies, infrastructure and social spending. The modelling suggests that by 2025, such tax reforms could lead to higher GDP and employment levels, while reducing carbon emissions and energy imports. The transition can be highly progressive when revenues are mainly used to increase social spending.

4.1 Introducing the macro-econometric model

The modelling framework

Cambridge Econometrics is a UK based company founded in 1978 as a spin-off from the University of Cambridge, to take forward the work of Prof Sir Richard Stone, Nobel Laureate in Economics.[391] Cambridge Econometrics developed the 'E3ME model', a computer-based macro-econometric model of global economies, used for analysing the detailed linkages between the economy, materials, environment and energy.[392] The model was originally developed through the European Commission's research framework programmes[393] and is now widely used in collaboration with a range of institutions for policy assessment, forecasting and research purposes.[394] E3ME covers details of 61 countries and regions, including China, India, Korea, Taiwan and Indonesia. The other countries in Asia are grouped in the 'rest of ASEAN' category. Based on the parameters and expertise developed in E3ME, Cambridge Econometrics has created the Framework for Modelling Economies and Sustainability (FRAMES) model to estimate potential tax revenues and macro-economic impacts for this study on Bangladesh.

Assumptions and limitations

The E3ME and FRAMES: Bangladesh models are based on a post-Keynesian economic framework and its assumptions are consistent with this branch of economics.[395] The approach is generally an empirical one, with behavioural parameters determined by relationships in the data. It is assumed that these relationships are maintained in the projection period, i.e. that behavioural responses remain consistent with those in the past. There are several important assumptions specific to this analysis:

Baseline projections. A 'baseline' scenario (assuming no policy intervention) was developed for the modelling, based on projections by the World Bank[396] and HSBC.[397] All results represent the difference on top of any changes that occur in the baseline.

National policy. The measures are introduced in the model on a national level in Bangladesh.

Phasing in. Policy measures are assumed to be introduced gradually from 2020, to reach the full measures by 2024 and remain the same beyond 2024. A linear path of introduction is applied over the five-year period 2020-2024, so the initial tax rates in 2020 are in general quite low.

Budget-neutrality. Each year, all revenues are used ('recycled') in accordance with the scenarios (this means there is no impact on the public deficit).

Price effects. The model captures price effects and does not include any awareness or signalling effects from the green taxes. This means that the responses to changes in tax rates should be attributed to the financial effects, rather than any publicity or virtue-signalling that accompanies the reforms.

Prices. All dollar-values in the results are in 2017 prices, unless specified differently.

Behavioural parameters. The behavioural parameters in the model are taken from E3ME. Bangladesh is not represented individually in E3ME; India was therefore chosen as the most appropriate region to be the proxy.

Impact beyond 2025. The tax reform is introduced gradually to 2024. The model assumes that by 2024, full behavioural responses are realised. Effects from 2025 onwards would be similar, unless further reform was introduced.

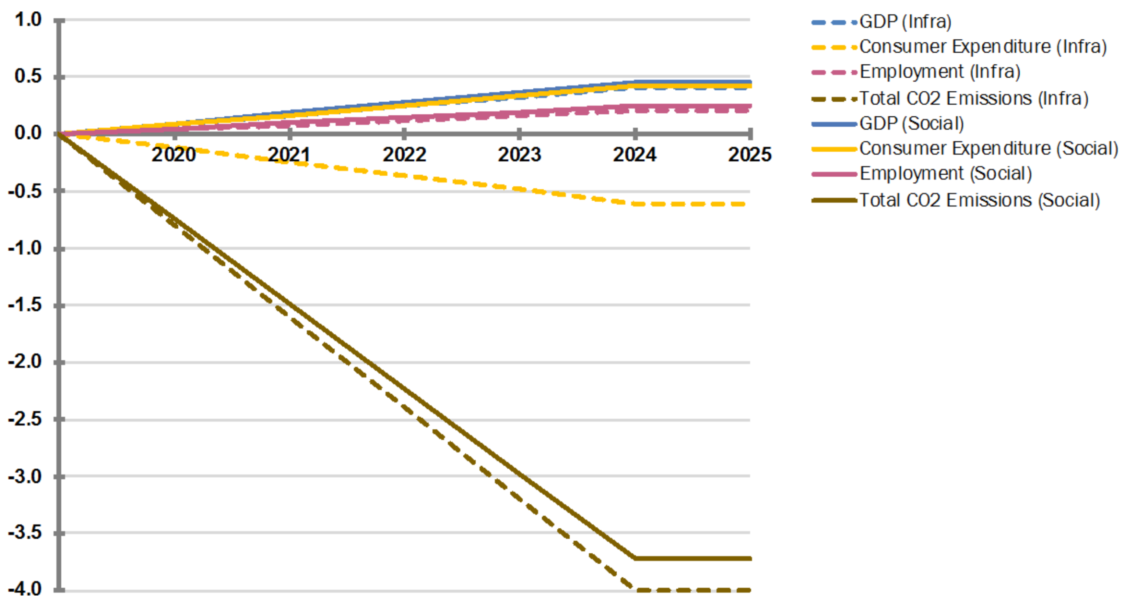
Appendix A provides a more detailed description of the model and the modelling results. Below is a summary of the key modelling results (section 4.2) and selected impacts by sector (section 4.3).

4.2 Key results

Addressing development and environment simultaneously

In the year 2025, both scenarios mentioned in section 3.3 are expected to raise $4.3 billion in revenues. In the modelling, every year, the revenues are fully recycled. In the *Infrastructure Scenario*, all revenues are recycled through investments in clean technology and infrastructure. In the *Social Spending Scenario* (or *'Social Scenario'*), all revenues are recycled through investments in clean technology and social spending. The key message from the results is that it is possible to design policy measures that reduce harmful emissions and final energy consumption, while at the same time stimulating the economy of Bangladesh, creating jobs and (in the *Social Scenario*) increasing income for the bottom 40 percent. These results demonstrate that Bangladesh doesn't need to choose between development and environment.

Figure 11: Overall result: decoupling (2020-2025, % difference from baseline, Bangladesh)



Source: Model projections, Cambridge Econometrics 2019.

Decoupling of GDP and carbon emissions

Figure 11 provides some key results over the 2020-2025 period, demonstrating decoupling effects in the scenarios, as GDP is higher, and emissions are lower. An increase in employment is observed in each scenario. The scenarios add $6.9 billion (in the *Infrastructure Scenario*) and $7.8 billion (in the *Social Scenario*) to GDP over the 2020-2025 period (Table 7 provides cumulative impacts). Additional findings include, over a six-year period:

- **Resource mobilisation.** Phasing out fossil fuel subsidies could potentially raise $4.7 billion in domestic resources, while a carbon tax could add another $10.6 billion in domestic resources.
- **Job creation.** Both scenarios show significant increases in employment (540,000 and 670,000 years of employment respectively).
- **Carbon emission reductions.** Both scenarios demonstrate a significant reduction in carbon emissions (saving 19.9 and 18.5 megatonnes of carbon respectively).
- **Savings on energy imports.** In both scenarios, Bangladesh saves significant amounts on energy imports ($429 million and $405 million respectively).

- **Public investments.** In the *Infrastructure Scenario* $12.8 billion is invested in infrastructure. In the *Social Scenario*, $12.9 billion is invested in social protection. Cleantech investments in both scenarios are $2.6 and $2.5 billion respectively.

Distribution of benefits and cost

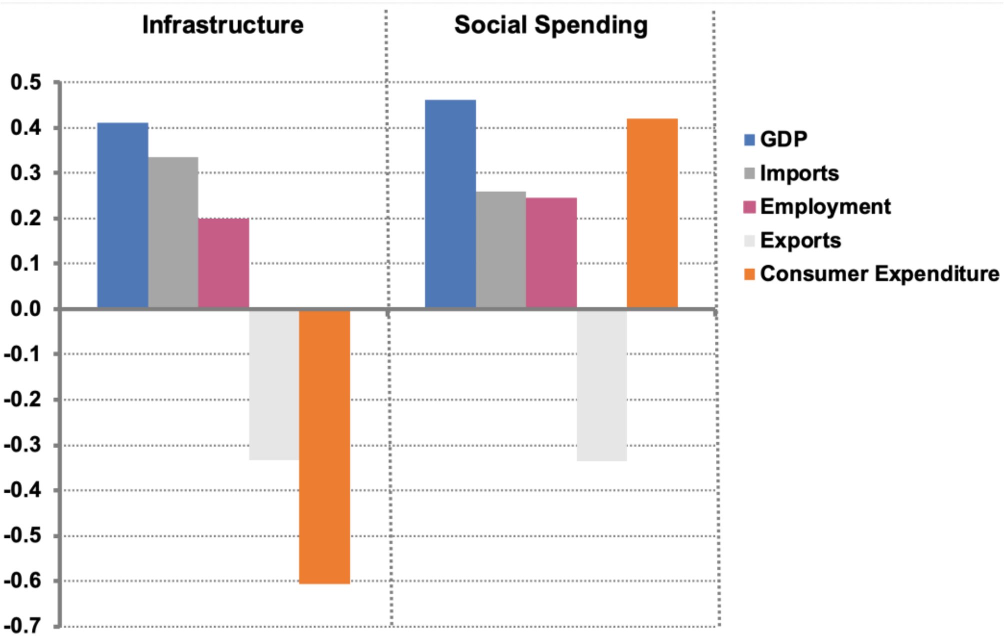
As with any reform, the benefits and costs will not be spread evenly (see section 4.3). In both scenarios, the textiles sector shows a slight negative result in terms of gross output (0.24% and 0.15% respectively) by 2025, but overall, the economy would be stronger and more competitive in terms of carbon intensity and energy import dependency. Also, it's important to note that the competitiveness impacts of the cleantech investments (totalling more than $2.5 billion) are not yet captured in the model. The modelling results suggest that a progressive impact with higher benefits (in relative terms) for lower income households is possible, particularly in the *Social Scenario*.

Consumer expenditure key difference between scenarios

A key difference between the scenarios is in consumer expenditure. Whereas the *Infrastructure Scenario* does not compensate low-income groups for increased living expenses, the *Social Scenario* specifically boosts consumer spending (see Figure 12).

- In the *Infrastructure Scenario*, total consumer expenditure is 0.6% lower than it is in the baseline, in real terms. The infrastructure investment creates jobs and there are positive multiplier effects throughout the economy. Price rises outweigh this effect, however, meaning household income and consumption are lower in real terms.
- In the *Social Scenario*, total consumer expenditure is 0.4% higher than the baseline, in real terms. The revenue recycled in social spending increases consumer expenditure and creates a stimulus effect which creates jobs. These effects are substantial enough to outweigh the effect of price rises.

Figure 12: Key modelling results (2025, % difference from baseline, Bangladesh)



Source: Model projections, Cambridge Econometrics 2019.

Table 7 and Table 8 provide details for a number of line-items.

Table 7: Cumulative results (2020-2025, difference from baseline, Bangladesh)

	Infrastructure Scenario	Social Scenario
GDP	$6.9 billion	$7.8 billion
Employment	543,000	670,000
CO_2 emissions	- 19.9 million tCO_2	- 18.5 million tCO_2
Final energy consumption	- 5,346,000 toe	- 4,720,000 toe
Energy import savings	- $429 million	- $405 million

Source: Model projections, Cambridge Econometrics 2019.

Table 8: Economic, social & environmental impacts (2025, difference from baseline, Bangladesh)

Difference from baseline	INFRASTRUCTURE		SOCIAL	
	(%)	(value)	(%)	(value)
Economic indicators				
GDP*	0.4%	$1.9 bln	0.5%	$2.2 bln
Output*	0.5%	$5.6 bln	0.4%	$4.2 bln
Consumer expenditure	-0.6%	-$2.2 bln	0.4%	$1.6 bln
Investment	3.3%	$4.8 bln	0.8%	$1.2 bln
Exports	-0.3%	-$0.2 bln	-0.3%	-$0.2 bln
Imports	0.3%	$0.4 bln	0.3%	$0.3 bln
Social indicators				
Employment	0.2%	139,000 persons	0.2%	172,000 persons
Change in household income poorest 1st quintile	-0.4%	-$4.7 bln	12.3%	$135.0 bln
Change in household income 2nd quintile	-0.4%	-$11.3 bln	4.9%	$129.1 bln
Environmental indicators				
Final energy consumption	-3.0%	-1,499 ktoe	-2.6%	-1,324 ktoe
CO_2	-4.0%	-5.6Mt	-3.7%	-5.2Mt

* Non-discounted.

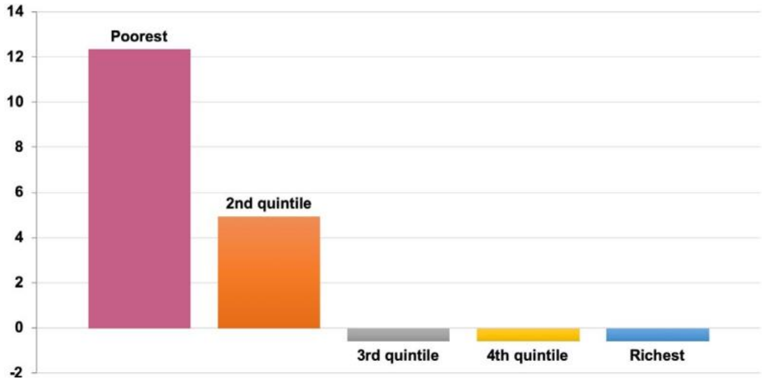
Source: Model projections, Cambridge Econometrics 2019.

Real incomes and inequality

Real incomes in the scenarios are affected by changes in wage income, income from government social spending, and prices. Rich and poor households spend their incomes in different ways and have different effective taxation rates; the impacts may vary across household groups. The important differences in the context of the scenarios are expenditure on energy and energy-intensive goods and services. In Bangladesh, higher income households spend a larger share of income in these areas, and therefore face higher price increases.

- In the *Infrastructure Scenario*, there are no explicit redistributive policies. The scenario is progressive, however, because the lower income quintile households experience smaller reductions in real incomes than those in the higher quintiles. Overall, the differences are small; the lowest quintile has a 0.4% real income reduction, compared to 0.6% for the highest quintile.
- When we account for the measure to boost incomes in the lowest two quintiles, the effect is substantially more pronounced. In the *Social Scenario*, real income increases by 12.3% for the lowest income quintile, and 4.9% for the second lowest. Real income in the highest three quintiles reduces by 0.6% (see Figure 13).

Figure 13: Social Scenario - real incomes per quintile (2025, % diff. from baseline, Bangladesh)



Source: Model projections, Cambridge Econometrics 2019.

The next section will provide a brief explanation on the impacts by sector, in terms of output, employment and carbon emissions.

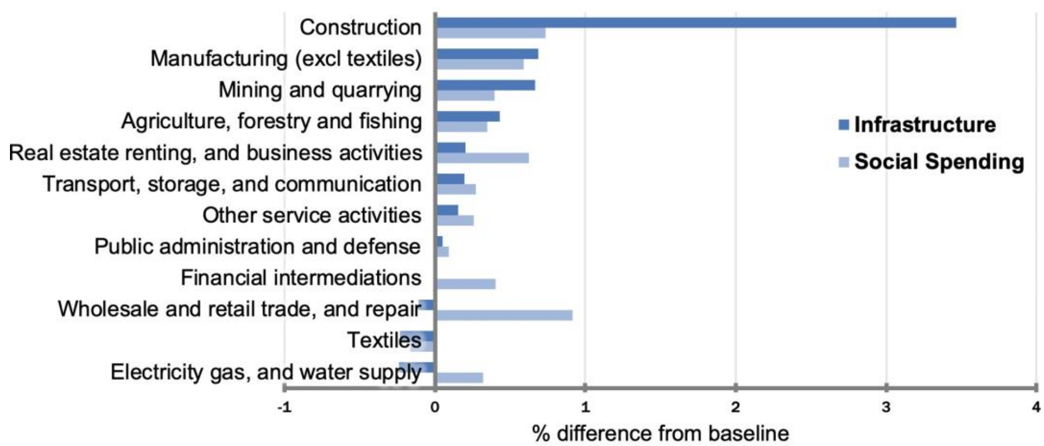
4.3 Impacts by sector

Output

Figure 14 provides the impacts of the scenarios on sectoral output. While GDP represents the value added in the economy, output is a gross measure that includes input material and energy (but not labour) costs.

- In the *Infrastructure Scenario*, the largest increases in output, both in relative and absolute terms, are in the construction, manufacturing (excluding textiles) and mining and quarrying sectors. These sectors benefit from the investments in infrastructure. Some of the manufacturing companies in the supply chain also benefit. Output falls marginally in sectors that are supplying consumer final demands, such as retail. In the textiles industry output falls because energy prices increase, leading to some loss of price competitiveness and lower exports.
- In the *Social Scenario,* most sectors demonstrate an increase in output as they benefit from higher local consumer spending. Manufacturing and construction also have relatively high increases, because of the investment in cleantech for textiles. Textiles lags behind due to an energy prices increase, leading to some loss of price competitiveness and lower exports. The overall implications and outlook for the textiles sector will be discussed in more detail below.

Figure 14: Output by sector (2025, % diff. from baseline, Bangladesh)



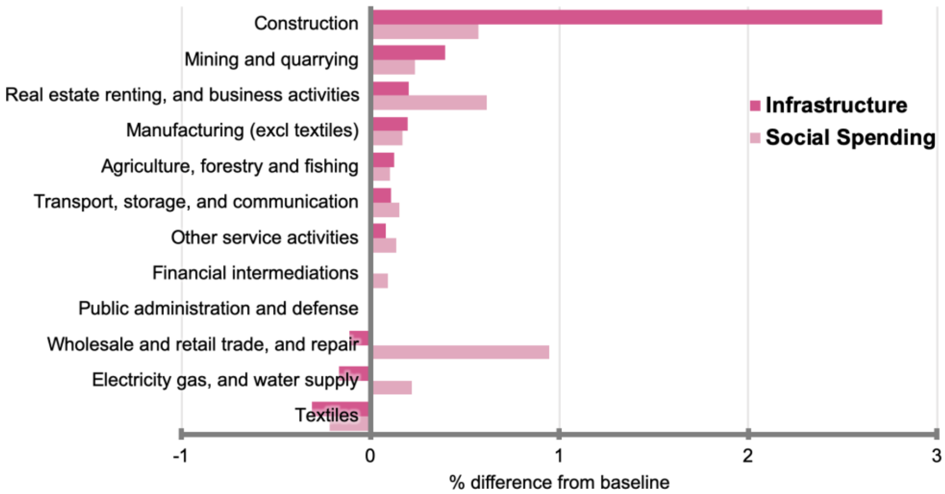
Source: Model projections, Cambridge Econometrics 2019.

Employment

The percentage changes in employment by sector (see Figure 15) largely follow the pattern of changes in output, whilst allowing for different returns to scale. Therefore, the largest changes are found in labour-intensive sectors, and those where output changes by the most.

- In the *Infrastructure Scenario*, the largest increases in employment, both in relative and absolute terms, are in construction, mining and quarrying and real estate (see Figure 15). These sectors benefit from the investments in infrastructure. Some of the manufacturing companies in its supply chain also benefit. In absolute terms, 63% of new jobs in this scenario are created in the construction sector. Agriculture creates the second greatest number of jobs, because of the size of the sector and its labour-intensity. Employment falls in the energy and utilities sectors because of reduced demand for energy products, and in the textiles industry because of some loss of price competitiveness and lower exports.
- In the *Social Scenario,* all sectors (except textiles) demonstrate an increase in employment as they benefit from higher local consumer spending. The textiles industry lags behind due to some loss of price competitiveness and lower exports. In absolute numbers, wholesale and retail trade create the most jobs (53% of the total), followed by agriculture and construction. Jobs are created in construction because of the investment in cleantech for textiles, and the induced positive effects in economy-wide investment.

Figure 15: Employment per sector (2025, diff. from baseline, # of employed persons, Bangladesh)



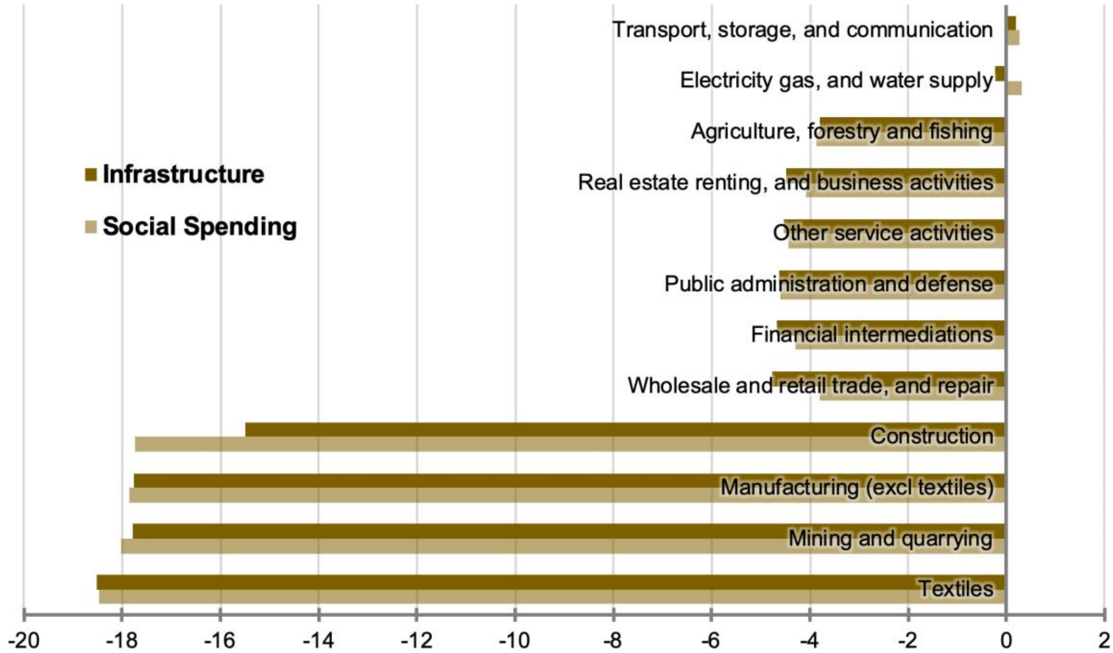
Source: Model projections, Cambridge Econometrics 2019.

Carbon emissions

In 2025, the policy measures in the scenarios reduce CO_2 emissions by 4.0% and 3.7% compared to the baseline, in the *Infrastructure Scenario* and *Social Scenario* respectively. The impacts on emissions from the different sectors vary according to their fuel mix, existing fuel prices (including tax rates) and whether they are included in the new measures. The largest proportional reductions in CO_2 in both scenarios is across the industrial sectors (see Figure 16). This is because, in Bangladesh, industry is responsible for approximately 85% of coal use, the fuel which is most affected by these reforms.

The power generation sector has minimal changes in emissions, because of limitations in the modelling framework. The model assumes that the power generation mix is constant over time and across scenarios. These tax reforms provide a strong incentive for different power generation technologies. However, the time horizon of analysis is 2025 and given the lifetime of power generation technologies, there would be limited retirement of capacity to be replaced over these years.

Figure 16: CO_2 emissions per sector (2025, % difference from baseline, Bangladesh)



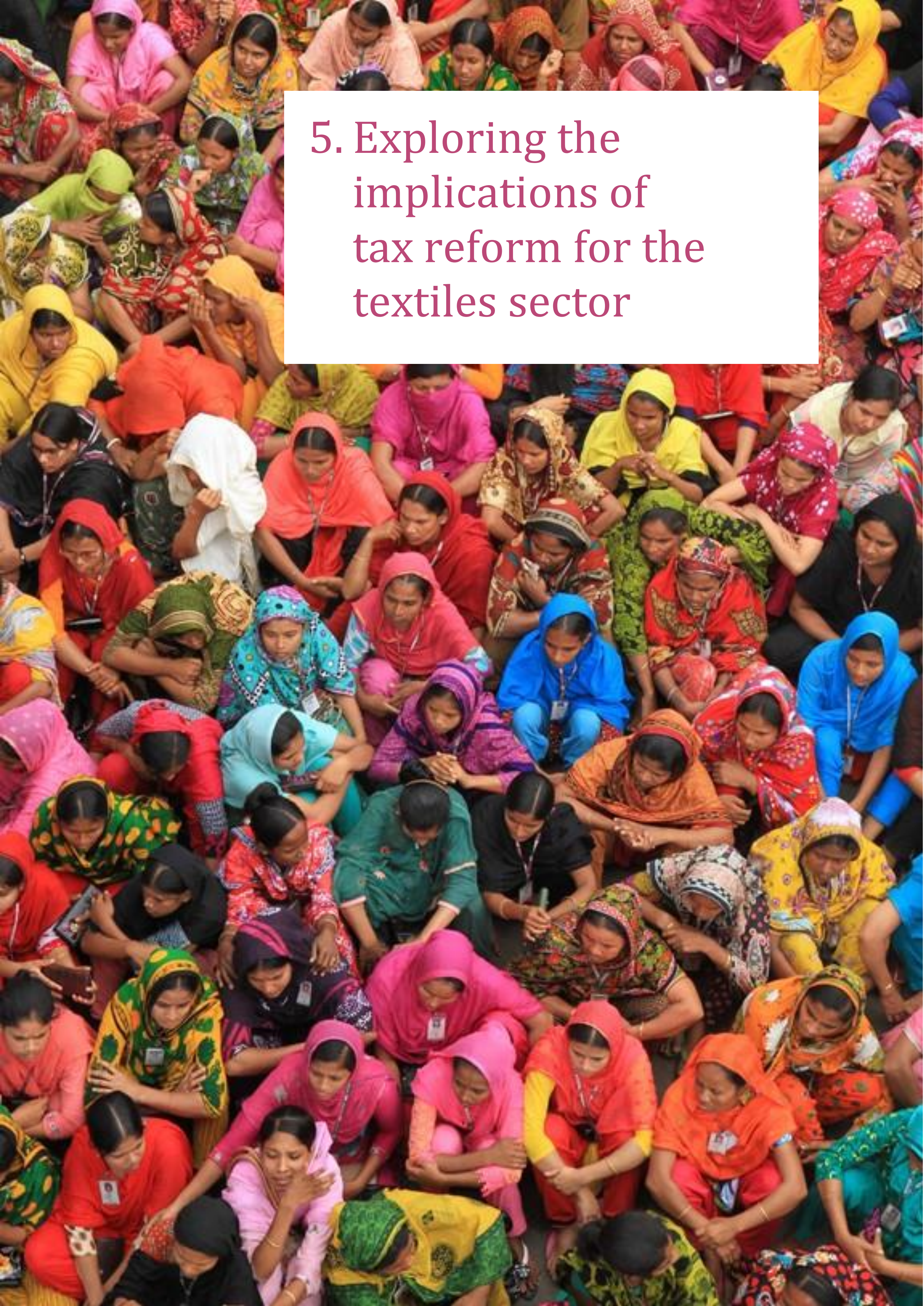
Source: Model projections, Cambridge Econometrics 2019.

Focus on the textiles sector

The textiles sector is unique in the Bangladeshi economy and in the dynamics it faces from tax reform. Textiles is the only sector that is reliant on exports, rather than domestic demand. It is therefore the most vulnerable to the loss of international competitiveness arising from increased costs of production resulting from tax reform. Exports reduce by 0.4 percent in both scenarios by 2025. A portion of the revenue accruing from the tax reforms is allocated to investing in the sustainability of production in the textiles industry. This investment would ameliorate the negative price competitiveness effects on the industry, with positive quality effects. These effects have not been quantified in the model.

Considering the importance of the textiles sector to the economy in Bangladesh, the next chapter will look closer at the perspectives and dynamics in the textiles sector.

5. Exploring the implications of tax reform for the textiles sector



The textiles sector in Bangladesh faces significant challenges to remain competitive in the face of global megatrends. This chapter reviews the dynamics of tax reform and its impact on the textiles sector in Bangladesh.

5.1 Setting the scene: global megatrends

The disposable clothes trend

Fast fashion constantly offers new styles to buy, as the average number of collections released by European apparel companies per year has gone from two in 2000 to five in 2011, with, for instance, Zara offering as many as 24 new clothing collections each year. This has led to consumers to see cheap clothing items increasingly as perishable goods that are nearly disposable, and that are thrown away after wearing them only seven or eight times.[398] Between 1996 and 2012, the amount of clothes bought per person in the European Union increased by 40 percent,[399] but about a third of those dresses, shirts and pants end up sitting in closets largely unused.[400] The fashion industry produces 100 billion garments per year; nearly 14 items of clothing for every person on earth.[401]

Massive environmental impact

Apparel and footwear account for 8% of global greenhouse gas emissions.[402] Globally, less than 1% of garments are recycled into new clothing. Every second, a garbage truck of textiles is landfilled or incinerated.[403] In 2015, the global textiles and clothing industry was responsrible for the consumption of 79 billion cubic metres of water, 1,715 million tons of CO_2 emissions and 92 million tons of waste. By 2030, under a business-as-usual scenario, these numbers would increase by at least 50%.[404]

Global fashion market committed to circularity

Leading industry groups, together with global fashion organizations, are pushing for the industry to change its ways. The 2020 *Circular Fashion System Commitment* was signed by 94 companies, representing 12.5 percent of the global fashion market. This commitment focuses on four immediate action points: 1) Implementing design strategies for cyclability; 2) Increasing the volume of used garments and footwear collected; 3) Increasing the volume of used garments and footwear resold; and 4) Increasing the share of garments and footwear made from recycled post-consumer textile fibres.[405]

Making the business case

The goals of the apparel industry to become sustainable and circular are ambitious especially since financial incentives embedded in current tax systems favour the business-as-usual linear economy. As indicated in Chapter 1, pollution and resource use are practically tax-free and even subsidized. In a high-volume, low-cost industry, such as the apparel industry, under these circumstances, it is particularly difficult to make a business case around saving water, using renewable energy and abolishing pollution. The development of sustainable supply chains requires more time, effort and R&D; all of which require more labour input than simply sustaining the linear model. In a system that puts a high or rising tax burden on labour, making such investments is even less financially attractive. Therefore, there is no level playing field for cleaner and innovative solutions.

The risk of corporations shifting their production to regions with ever-lower wages and lower environmental standards is eminent. Countries like Bangladesh therefore are required to perform a balancing act, combining a need to reduce environmental and health damage, while increasing the number of decent jobs *and* keeping costs as low as possible, in order not to deter producers. This struggle is likely to intensify if global trade is to adhere to the goal of keeping global warming within safe limits, as will be discussed next.

5.2 Staying competitive in a 1.5-degree warmer world?

A global competitive market

Bangladesh is battling to keep its position as the world's second-largest exporter of clothing after China, as it faces intensifying competition from Cambodia, Vietnam, Myanmar and now African countries like Ethiopia, as global brands search for cheap labour. H&M, for instance, has started sourcing from an Ethiopian clothing factory it set up with garment maker DBL.[406] Ultimately, to break this cycle of shifting to countries with ever-lower production costs, consumers (in high-income countries) will probably need to pay more for products.[407] Paying living wages to garment workers would add just one percent to the retail price of a piece of clothing.[408] However, if all negative social and environmental impacts were taken into account, a pair of jeans from Bangladesh, for example, would cost €33 more.[409]

Textiles industry at crossroads

The global market is changing fast, with water supply risks and carbon pricing on the rise. In Bangladesh:

> *"If "business as usual" water demand continues for the textile sector, in particular, this will result in an additional water demand of over 6,750 megalitres per day by 2030. This is equivalent to the annual water needs of a population of approximately 60 million people in Bangladesh.*
>
> *(…) It is estimated that the level of investment in new assets (water abstraction treatment and distribution plant as well as effluent treatment plant) to support growth in the textile sector will be in the order of $19 to $30 billion through to 2030 under a "business as usual" water demand scenario."(WRG 2015)* [410]

It is clear that in future, water usage will not be free of charge, as the costs of water scarcity to society can no longer be ignored. It's also clear that carbon emissions can't be free of charge - or even subsidized - in a 1.5°C warmer world. Nor can brands ignore the impacts of toxic chemicals and the ever louder call for more social practices, such as paying living wages and creating a safe working environment. Global demand for clothing is also changing, with resale growing 21 times faster than the retail apparel market over the past three years.[411] The textiles industry is therefore at a crossroads; continuing the linear model (while imposing external costs to society and future generations), or shifting to circular models, and adapting to changing circumstances. According to the Ellen MacArthur Foundation, a leading think tank in sustainability, a 'New Textiles Economy' is 'distributive by design' and 'reflects the true cost (environmental and societal) of materials and production processes in the price of products'.[412]

Textiles and tax reform

This study demonstrates how aligning tax policy with the SDGs can be relatively neutral to the sector while sustaining an overall better functioning economy, higher investments in future-proofing technologies and higher consumer spending in Bangladesh. Will this be reason enough for the fashion producers to support tax reform? Maybe not; as nobody likes to pay more for something that was previously for free. But looking at global trends, tax reform, including fossil fuel subsidy reform, would be a way to reduce risks and future-proof the sector. According to the World Bank, carbon taxes in Bangladesh can benefit firms, including exporters:

- There is well-established empirical evidence that environmental regulations can stimulate innovation.[413] Note that the scenarios under review directly contribute to innovation in the textiles sector.
- A carbon tax would allow firms producing in Bangladesh to market their products as more sustainable than those produced in other countries.[414]
- A carbon tax would help Bangladeshi exporters get 'ahead of the curve' as consumers (and laws) in developed markets become more environmentally conscious in their sourcing of imports.[415]

There is a risk of carbon leakage if firms leave Bangladesh for countries without carbon pricing mechanisms. The evidence to date suggests that such negative impacts are non-existent to minimal.

However, they may impact some sectors, and Bangladesh's garment sector may be one example that deserves consideration. The World Bank notes that the risks are reducing as more countries impose a carbon tax.[416] Also, research shows that investments in resource efficiency, secure work environments and sustainable materials would actually boost profitability by up to 1-2 percentage points in EBIT margin by 2030.[417]

Opportunities for circular business models in Bangladesh?

Impacts on global supply chains of circular practices need to be researched, as many issues remain unclear. For example:

- How could Bangladesh shift from activities with relatively low value-added towards higher value-added activities, such as design, reuse and customization and towards production methods with a smaller footprint and more quality employment?
- How could smart policies support the transition to a circular supply chain? In Bangladesh, a reduced tax rate of ten percent has been introduced for garment factories that have an internationally recognized green building certification.[418] Is this measure effective? Should it be complemented with other policies?
- How could a country like Bangladesh be part of the 'closed loops' of fashion brands? Could products be returned to Bangladesh in a responsible way to be recycled or modified?
- What are the opportunities in local or regional circular business models? How to connect local and regional loops?
- If shipping were a country, it would be the sixth biggest in terms of emissions share.[419] How will global trade be sustained in a 1.5-degree warmer world? Will high-volume carbon-neutral shipping be possible?

Questions like these should be the subject of continued research with and in Bangladesh.

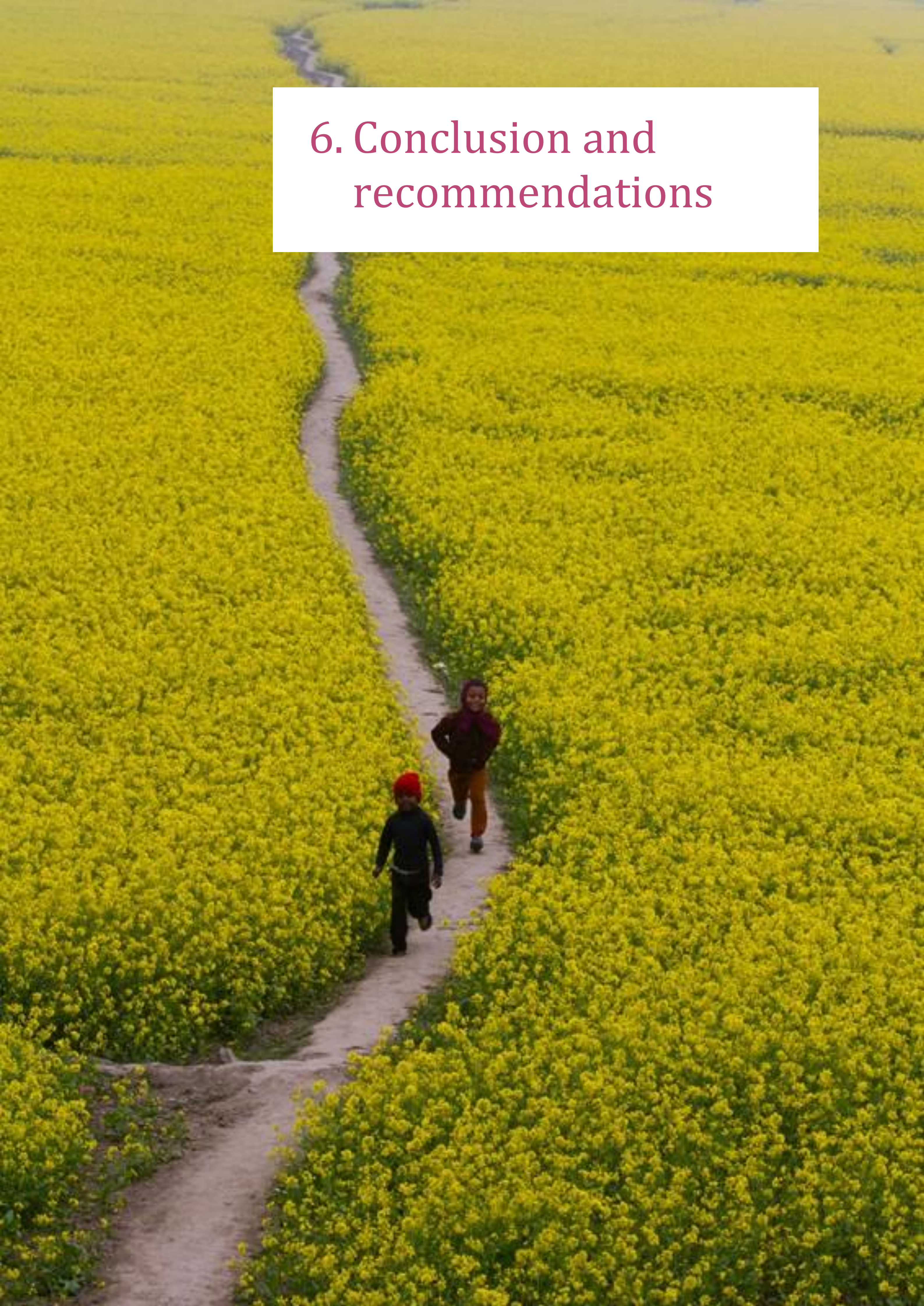
Adaptation in the DNA of business

The textiles sector is an important driver for growth in Bangladesh, but it still fails to pass on equally to the population. 'Business as usual' will be difficult to sustain considering global megatrends such as climate disruption and displacements, water supply risks, the global focus on the SDGs, social needs, and circular business models. Fortunately, adapting to changing circumstances is in the DNA of business and the global sense of responsibility in business is growing. As the CEO of Royal DSM (an €8.6 billion health, nutrition and materials company) stated:

> *"[As business leaders] We cannot be successful, nor call ourselves successful, in a society that fails. The increased impact and power of business need to lead to an increased responsibility to contribute to the real, higher goals of our economy, to serve society."*[420]

Considering all of the above, business can and should play a prominent role in assisting governments in aligning tax systems with the SDGs.

6. Conclusion and recommendations



We have entered the SDG era; an era of unprecedented global social and environmental challenges. The most daunting task will be to adapt the metabolism of our economies to match the carrying capacity of the earth and stay well below 2°C global warming. We face equally important social challenges in our societies, including enabling a growing population to develop to their full potential and find decent work.

Aligning economic growth with the goals of the SDGs will be key. The linear (take-make-waste) economy is no longer maintainable. A shift is needed towards inclusive circular economies, which are regenerative, carbon neutral and distributive. Tax systems play a fundamental role in this transition and there is now widespread support for the principles of tax reform; putting a price on pollution and resources and using the revenues for social impact.

Updating the tax system is not a simple task, especially in countries with low- and middle-incomes, which face the multiple challenge of developing the economy and social systems, while at the same time preserving natural resources. This study confirms that countries may not need to choose between those goals. Smart policies could help countries to 'leapfrog' into the SDG era.

It may be clear that many details and complications still need to be researched. The question is whether to resolve these issues or allow them to immobilize our current systems, that were built for a different era.

We therefore call upon all stakeholders, businesses, governments and NGOs to do what is in their power to turn tax into a force for good. And to help build modern tax systems that enable prosperity based less on natural resource use and more on the abundance of human capacities and talents. For this is growth that can be sustained by generations to come.

Below are four recommendations for next steps in Bangladesh and other countries to be taken by business leaders and governments.

RECOMMENDATIONS FOR BUSINESSES:

1) Evaluate the risks and opportunities related to global environmental and socio-economic megatrends.

Companies should focus on getting the insights necessary to evaluate the company's external costs and benefits and disclose consistent information on the risks and opportunities.

2) Gain and share insights on the impact of tax reform from a business perspective.

Tax reform changes the dynamics in business. There is a substantial lack of knowledge about the risks and opportunities for companies; how does a shift in taxation affect strategic choices concerning products, services and new technologies? Businesses should help governments gain more insight in the transformational power of businesses. This will enable a well-informed discussion between policy makers and businesses.

3) Lead by example.

Businesses can be a gamechanger for the SDGs. Business leaders could lead by example by:

- Joining the global community in support of climate action and carbon pricing.
- Applying internal carbon pricing and extending such mechanisms to other externalities.
- Shifting towards more inclusive and sustainable business models, thereby contributing to the goals of the SDGs.

4) Engage proactively with government to implement policies to support the SDGs.

Businesses should engage proactively with governments in the process of aligning public and private interests in support of the SDGs. Responsible business associations could play a significant role in this process.

RECOMMENDATIONS FOR GOVERNMENTS:

1) Extend data systems to have accurate information in place for effective policymaking.

A robust and future-proof tax system will require adequate risk assessments and increasing level of responsiveness to urgent matters. Detailed and up-to-date economic, environmental and social data are needed to assess the potential for policy measures. This starts with detailed measurement of the metabolism of our economies.

2) Create interdisciplinary research programs.

As tax policy is intertwined with economic, environmental and social issues, a systemic and long-term approach is needed. Fostering cooperation between government departments (Tax, Finance, Environment, Economic Affairs and Employment), as well as businesses and other stakeholders (such as NGOs and research agencies), will be key for the development of effective and fair policies.

3) Start the implementation process.

Practical steps towards tax reform include:

Step 1: Assessing the pathway necessary to achieve national, regional and global ambitions.

Step 2: Putting a price on pollution and natural resource use, starting with abolishing fossil fuel subsidies and pricing carbon emissions.

Step 3: Using the revenues to lower the tax burden on labour, improve social protection (in particular addressing the needs of lower-income households) and increase public investments.

Step 4: Monitoring and adjusting policy measures over time.

During the process, engaging with businesses and the public ahead of any change and communicating the impacts in a transparent manner will be key.

4) Seek international cooperation.

Work together with other countries and regions to achieve a coherent international tax strategy serving the SDGs. This lays the ground for global coordination.

The world has moved on; tax systems need to do the same.

Appendix A: FRAMES: Bangladesh

By Cambridge Econometrics

Description of the model

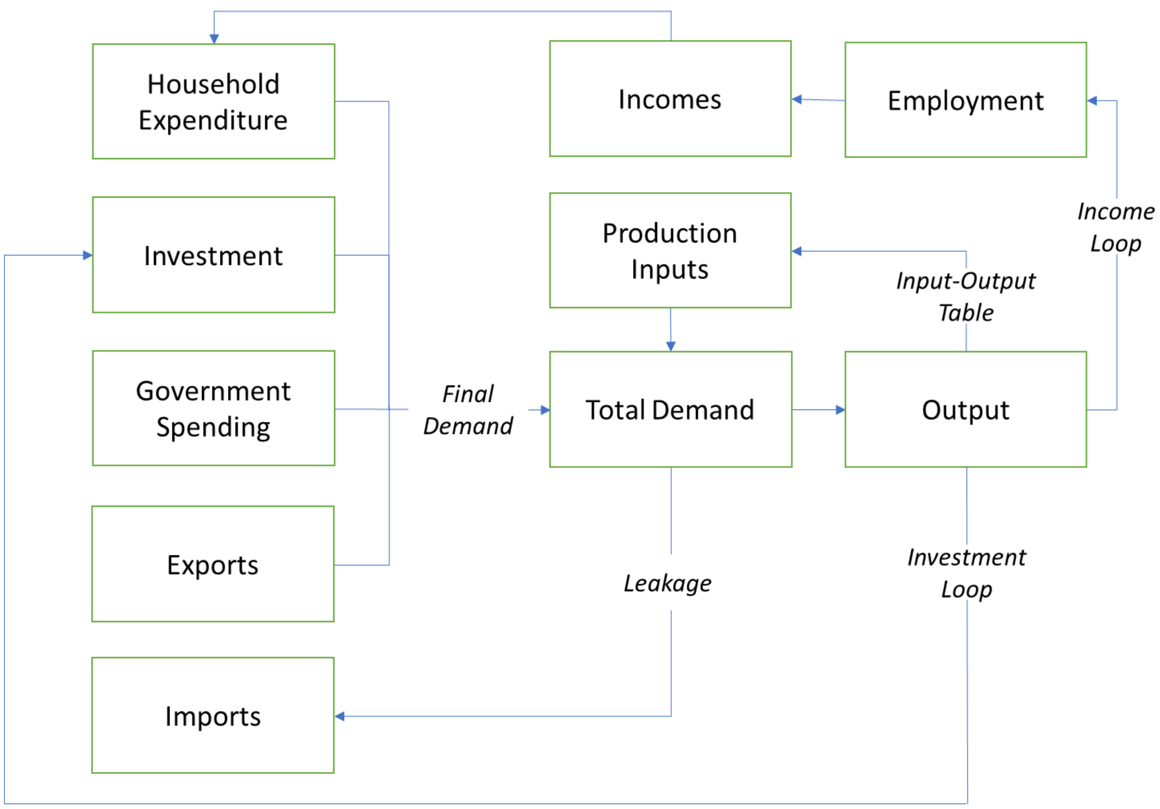
FRAMES: Bangladesh is an economic model of the Bangladeshi economy, developed specifically for this study, by Cambridge Econometrics. The model was built to examine the socioeconomic and environmental effects of energy-environment-economy (E3) policies in Bangladesh.

The key features of FRAMES: Bangladesh are:

- An economic accounting framework based on the system of national accounts.
- Integrated treatment of the economy, energy, and the environment, with linkages between each component.
- Detailed sectoral disaggregation, and a national level input-output table, reflecting the specific structure of the economy.
- Calculations of income effects by quintile, providing distributional results.

Figure 1 details the basic economic structure in the model. At the core of the economic modelling in FRAMES: Bangladesh is a national input-output table for Bangladesh[1]. Relationships for investment, prices, employment, and trade are modelled using elasticities which have been econometrically estimated. The FRAMES: Bangladesh model is based on a post-Keynesian economic framework, and its assumptions are consistent with this branch of economics. The application of this theory to economic modelling are informed by E3ME[1], a computer-based model of global economies, used for analysing the detailed linkages between the economy, materials, environment and energy.

Figure 1: Economic Structure in FRAMES: Bangladesh



Modelling ETR

The analysis in this study focuses on a scenario of Environmental Tax Reform (ETR) in Bangladesh; specifically, adjustments to fossil fuel consumption subsidies, and introduction of a carbon tax. The first order effect of both policies is to increase the price of fuel use; the two measures are additive in their effect on prices. The revenues generated by these reforms are recycled. The details of the polices are provided below.

Carbon Tax:

- The carbon tax rate in 2025 is \$30/tCO_2 (2017 prices).
- The carbon tax levied per unit of energy use is determined by calculating the carbon content of individual fuels for each unit of energy.
- The carbon tax rate is added to the price of fuel use for all fuel users affected by the tax.
- The carbon tax is only levied on power generation and industry. The residential and transport sectors are not covered by the tax.

Oil and Natural Gas Consumption Subsidies:

- The value of oil and natural gas consumption subsidies are calculated using data from IEA. In the absence of data detailing the relative subsidies received by different fuel users, the per unit subsidy is calculated by dividing total subsidy value by total fuel use. In the baseline, the per unit subsidy is assumed to be constant over time.
- The value of the withdrawn subsidy is added to the prices of oil and natural gas use, for all fuel users affected by the tax.
- The subsidies are withdrawn only from power generation and industry. The residential and transport sectors are not affected.

Revenue Recycling:

- By design, the government implements full revenue recycling so that the tax reforms are revenue neutral. The full value of the carbon tax receipts, and the savings from subsidy removal are offset by compensating measures.
- In both scenarios, a share of the revenue from ETR is allocated to compensate the textiles sector for the negative impacts it faces from ETR. The value of this compensation is equal to the reduction in gross value added (GVA) in the textiles sector in each scenario. The compensation is in the form of 'cleantech' investment, directed to improve the sustainability of production practices in the Bangladeshi textile industry.
- In the first scenario, remaining revenue is spent on a programme of public investment in infrastructure. The exact infrastructure projects are not defined; the supply side effects of the policy are not modelled.
- In the second scenario, remaining revenue is spent on benefit payments to the bottom two quintiles in the income distribution. Benefit payments are spent equally on the two quintiles. The exact nature of the payment is not defined; in the modelling framework it is treated as a basic transfer from government to households.

Note that if a carbon tax was levied on transport fuels, total revenues would be notably larger, given that transport is responsible for over 11 percent of fossil fuel consumption in Bangladesh. Subsidy removal would be less significant because the unit subsidy on oil is relatively small. The effects of tax reform would then be directly felt by households. Consumer price rises would be larger. Further, the energy import bill would reduce substantially more than in the current scenario. Oil is the main component of the energy import bill, and transport, currently exempt in the scenario, is the largest consumer of oil.

Limitations and Assumptions

- A ‘baseline’ scenario was developed for the modelling. The importance of the baseline is minimal, because the modelling framework solves scenarios as differences from the baseline. The assumed GDP growth in the baseline is 7.1% per annum to 2030, taken from ‘The World in 2030’ (HSBC, 2018). The report provides details of its assumptions to produce the growth forecasts. The working-age population growth rate is assumed to be 1.6% per annum (extrapolation of the 1.6% per annum from 2018-2023 detailed in HSBC (2018)).
- The baseline assumes that the individual components of GDP grow at the same rate as total GDP. Labour force is assumed to grow in proportion to working-age population (constant labour participation rate). Energy use per unit of gross output is assumed to be constant over time. The proportion of income accruing to each quintile is assumed to be constant over time.
- Total power generation equals demand in each given year. Composition of the power generation mix is assumed to be constant over time. This is equivalent to assuming that as any capacity retires, it is replaced with the same technology. And that investment in new capacity follows historical shares.
- Environmental tax reforms are modelled to be introduced linearly to 2024. By 2024, the carbon tax rate is \$30/tCO_2 (2017 prices), and oil and natural gas subsidies are fully removed for power generation and industry.
- As noted above, by design, each scenario is budget-neutral in terms of policy costs/revenues.
- The behavioural parameters in the model are taken from E3ME. Bangladesh is not represented individually in E3ME; India was therefore chosen as the most appropriate region to be the proxy.
- Switching between fuels is not estimated in the modelling. Coal, oil, and gas use long-run price elasticities from E3ME. The values of these estimates are taken from literature, rather than econometrically estimated. See the E3ME manual (https://www.e3me.com/wp-content/uploads/2019/04/E3ME-Technical-Manual-v6.1.pdf).
- The cost pass-through rate in each sector (share of change in costs passed on to final prices) is determined by the econometric parameters; importantly, reflecting different levels of competitiveness in individual sectors. The exception is power generation, which is not subject to international competition: here, the full cost of taxes is passed through to prices.
- Change in demand for oil is directed to imports, given the extant minimal domestic production in Bangladesh. Change in demand for coal is met by a reduction in domestic production, and reduction in imports, proportional to the import share in 2016. Change in demand for gas is met entirely by adjustments to domestic production. Bangladesh’s cumulated natural gas consumption to 2030, in the modelling baseline, is less than total natural gas reserves (data for natural gas reserves is taken from BGR (2015) (https://www.bgr.bund.de/EN/Themen/Energie/Downloads/energiestudie_2015_en.pdf?_blob=publicationFile&v=2). This assumption would need to be reconsidered if the modelling horizon extended beyond 2030.
- **National policy.** The measures are introduced in the model on a national level in Bangladesh. Policy in all other global regions is constant across scenarios.
- **Price effects.** The model captures price effects and does not include any awareness or signalling effects from the green taxes. This means that the responses to changes in tax rates should be attributed to the financial effects, rather than any publicity or virtue-signalling that accompanies the reforms.
- **Prices.** The model is solved in constant prices, in Bangladeshi taka, 2016 prices.
- **Impact beyond 2025.** The tax reform is introduced gradually to 2024. The model assumes that by 2024, full behavioural responses are realised. Effects from 2025 onwards would be very similar, unless further reform was introduced. The caveat is that Bangladesh has limited natural gas reserves; economic benefits of reduced gas use would increase if natural gas was not sourced domestically.

Scenario results

Scenario results

The ETR policies are modelled across two scenarios of revenue recycling. For the ‘infrastructure scenario’, revenues are spent on a programme of investment in public infrastructure. For the ‘social spending scenario’, revenues are spent on increasing the real incomes of the lowest two income quintiles.

Variable	Infrastructure	Consumption
GDP	0.4	0.5
Consumer Expenditure	-0.6	0.4
Investment	3.3	0.8
Imports	0.3	0.3
Exports	-0.3	-0.3
Total CO2 Emissions	-4.0	-3.7
Employment	0.2	0.2
Employment ('000s)	139	172
Environmental Tax Revenue as a Share of Total Tax Revenue	11.8%	11.9%
Total Environmental Tax Receipt (Million 2017 USD)	4305	4314
Total Final Energy Consumption (% baseline)	-3.0	-2.6
Total Tax 2020-2025 Cumulative (% baseline)	8.3%	8.3%

National Level Results

GDP

GDP is higher than the baseline in both scenarios: 0.4% in the infrastructure scenario, and 0.5% in the social spending scenario. The main driver of positive macroeconomic impacts is the effect of redistributing profits to investment and consumption. Prices in the economy generally increase less than the cost of the environmental taxes, subject to the level of competition in each sector, leading to a reduction in profits. The full values of the taxes are recycled, however, leading to a net stimulus effect. Reductions in energy use also produce positive macroeconomic effects because of the reduction in the value of energy imports.

Consumption (Household Expenditure)

In the design of the tax reform, none of the reforms directly affect households. Consumer prices do increase across consumption categories, however, because power generation and industry face higher costs of production.

- In the infrastructure scenario, total consumer expenditure is 0.6% lower than it is in the baseline, in real terms. Nominal incomes are higher than in the baseline; the infrastructure investment creates jobs and there are positive multiplier effects throughout the economy. Price rises outweigh this effect, however, meaning household income and consumption are lower in real terms.
- In the social spending scenario, total consumer expenditure is 0.4% higher than the baseline, in real terms. The revenue recycled in social spending increases consumer expenditure and creates a stimulus effect which creates jobs. These effects are substantial enough to outweigh the effect of price rises.

Investment

Investment is higher in both scenarios than in the baseline. The positive macroeconomic results in both scenarios mean higher production levels in the economy, which stimulates investment in additional productive capacity. The investment increase is much greater in the infrastructure scenario, because the revenue recycling mechanism directly increases investment in the economy. Investment is 0.8% higher in the social spending scenario, and 3.3% higher in the infrastructure scenario.

Imports and Exports

- Total imports are higher in both scenarios than in the baseline, by a similar amount. Higher levels of production in the economy increases the demand for imports of production inputs. Part of the higher consumer expenditure in the social spending scenario is spent on imported goods. Imports are a 'leakage' from the domestic economy, reducing the positive multiplier effects of the investment and consumption stimuli.
- Energy imports are lower in both scenarios, because higher prices of fuel use reduce demand. The value of coal imports is approximately 34% lower in both scenarios, and oil imports are 1% lower. The reduction in coal imports is much greater because: 1) the proportional price increase of coal is substantially more than for oil (coal is less expensive per unit of energy, and contains more carbon); 2) transport is protected from the tax reforms, and transport is responsible for 60% of the final energy consumption of oil products.
- Total exports are lower than in the baseline in both scenarios. Bangladeshi firms face higher costs of production because of the direct tax incidence, and the higher prices of domestic production inputs. Resulting price increases reduce the competitiveness of exports from Bangladesh. If other regions globally were to implement comparable environmental policy, this competitiveness effect would be mitigated. Investment is made in the sustainability of production in the textiles sector, to compensate for this effect, and protect the long-term competitiveness of Bangladesh's most important export sector.

Employment

Total employment increases in both scenarios, by 0.2%. Employment increases as a result of higher economic activity in each scenario. The revenue recycling mechanisms more than outweigh the negative effect on output of price increases due to higher energy costs.

Energy Consumption

Total final energy consumption falls in both scenarios, as expected. Carbon tax and subsidy removal directly increase the price of fuel use, reducing demand. In the absence of revenue recycling, energy consumption in the model is reduced by 3.9%. In the infrastructure and social spending scenarios, however, energy consumption decreases by 3.0% and 2.6%, respectively, given the rebound effects of higher production and consumer expenditure.

CO_2 emissions

Both scenarios have lower total CO_2 energy emissions than the baseline. CO_2 emissions fall by 4.0% and 3.7% in the infrastructure and social spending scenarios, respectively. The reduction in CO_2 is greater than energy consumption; the carbon tax increases the price of coal use substantially given its baseline low price relative to other fuels, and high carbon content. The tax levied on natural gas and oil is a much lower share of the baseline price.

Air Pollution

None of tax reforms in the scenarios directly affect air pollution, but given the reforms reduce use of polluting energy products, air pollutants such as SOx, NOx, PM_{10} and $PM_{2.5}$ would be expected to fall as well. These effects have not been quantified in the modelling.

Inequality/Real Incomes

Real incomes in the scenarios are affected by changes in wage income, income from government social spending, and prices. Households in different income groups spend their income in different ways. The important differences in the context of ETR are expenditure on energy and energy intensive goods/services. In Bangladesh, higher income households spend a larger share of income in these areas, and therefore face higher price increases.

- In the infrastructure scenario, there are no explicit redistributive policies. The scenario is progressive, however, because the lower income quintile households experience smaller reductions in real incomes than those in the higher quintiles. Overall, the differences are small; the lowest quintile has a 0.4% real income reduction, compared to 0.6% for the highest quintile.
- In the social spending scenario, the inequality results are substantially more marked. The revenue recycling mechanism is designed to improve the incomes of the bottom two quintiles. Real income in the highest three quintiles reduces by 0.6%. But real income increases by 12.3% for the lowest quintile, and 4.9% for the second lowest.

Sector Level Results

Output

The main differences in the output structure of the economy are determined by changes in exports, and the revenue recycling mechanism. The modelling framework uses a fixed input-output structure and does not include a treatment of consumption substitution across categories.

- In the infrastructure scenario, the sectors with largest increases in output are construction, manufacturing (excluding textiles) and mining and quarrying. The public infrastructure investment increases demand substantially in each of these sectors, either directly, or indirectly through supply chains. Gross output is marginally lower in sectors which are supplying consumer final demands, such as retail.
- In the social spending scenario, gross output increases in all sectors except textiles. The sectors with the largest increases are those associated with consumer expenditure. Manufacturing and construction also have relatively high increases, because of the investment in ‘cleantech’ for textiles. Textiles loses out because of a loss of exports.

Employment

The percentage changes in employment by sector largely follow the pattern of changes in output, whilst allowing for different returns to scale. Therefore, the largest changes are found in labour-intensive sectors, and those where output changes by the most. In the infrastructure scenario, 63% of new jobs are created in the construction sector. Agriculture creates the second greatest number of jobs, because of the size of the sector and its labour-intensity. In the social spending scenario, employment changes are more even across the economy. Wholesale and retail trade create the most jobs (53% of the total), followed by agriculture and construction. Jobs are created in construction because of the investment in ‘cleantech’ for textiles, and the induced positive effects in economy-wide investment.

CO_2

The largest proportional reductions in CO_2 in both scenarios is across the industrial sectors. This is because, in Bangladesh, industry is responsible for approximately 85% of coal use, the fuel which is most affected by these reforms. The fuel user contributing least, proportionally, to emissions reductions is the residential sector; the residential sector was protected in scenario design from the tax reforms. In the social spending scenario, emissions from the residential sector increase, as total consumer expenditure increases. The power generation sector has minimal changes in emissions, because of limitations in the modelling framework. The model assumes that the power generation mix is constant over time and across scenarios. These tax reforms provide a strong incentive to different power generation technologies. However, the time horizon of analysis is 2025 and given the lifetime of power generation technologies, there would be limited retirement of capacity to be replaced over these years.

Energy Consumption

Changes in energy consumption by fuel user follow a very similar pattern to the CO_2 results, though the differences across sectors are less marked. Where industrial sectors reduce coal use, the relative CO_2 reduction is larger than that of energy use.

Textiles Sector

The textiles sector is unique in the Bangladeshi economy, and in the dynamics it faces from ETR. Textiles is the only sector that is reliant on exports, rather than domestic demand. It is therefore the most vulnerable to the loss of international competitiveness arising from increased costs of production resulting from tax reform. Exports reduce by 0.4% in both scenarios by 2025. A portion of the revenue accruing from the tax reforms is allocated to investing in the sustainability of production in the textiles industry. This investment would ameliorate the negative price competitiveness effects on the industry, with positive quality effects. These effects have not been quantified in the model.

Model Classifications

Sectors
1. Agriculture, forestry & fishing
2. Mining & quarrying
3. Manufacturing (excl. textiles)
4. Textiles
5. Electricity gas, & water supply
6. Construction
7. Wholesale & retail trade, & repair
8. Transport, storage, & communication
9. Financial intermediations
10. Real estate renting, & business activities
11. Other service activities
12. Public administration & defence

Fuel Users
1. Agriculture, forestry & fishing
2. Mining & quarrying
3. Manufacturing (excl. textiles)
4. Textiles
5. Electricity gas, & water supply
6. Construction
7. Wholesale & retail trade, & repair
8. Transport, storage, & communication
9. Financial intermediations
10. Real estate renting, & business activities
11. Other service activities
12. Public administration & defence
13. Residential

Consumption Categories
1. Food & non-alcoholic beverages
2. Alcoholic beverage, tobacco & narcotics

3. Clothing & footwear
4. Housing, water, electricity, gas & other fuels
5. Furnishings, household equipment & household maintenance
6. Health
7. Transport
8. Communication
9. Restaurants & hotels
10. Miscellaneous goods & services

Fuels
1. Coal
2. Oil
3. Natural Gas
4. Electricity
5. Biofuel

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Article

Taxation for a Circular Economy: New Instruments, Reforms, and Architectural Changes in the Fiscal System

Xavier Vence [1,*] and Sugey de Jesus López Pérez [2]

[1] ICEDE, CRETUS, Applied Economics Department, Faculty of Economics, Campus Norte, University of Santiago de Compostela, 15782 Santiago de Compostela, Spain
[2] ICEDE (USC), Faculty of Accounting and Administration, Autonomous University of Sinaloa, 80010 Culiacán, Mexico; sugeydejesus.lopez@usc.es
* Correspondence: xavier.vence@usc.es

Abstract: This article addresses fiscal policy as a key instrument for promoting the transition to a circular economy. It is based on the hypotheses that (1) the current tax system penalizes circular activities, which are generally labour intensive, as opposed to new product manufacturing activities, which are generally intensive in materials and energy, highly automated and robotized, and (2) that the environmental taxation implemented in recent decades is unable to introduce significant changes to stop climate change or keep the economy within planetary ecological limits. This article examines the basis of an alternative tax system and tax instruments for correcting the current linear economy bias and driving the transition to a circular economy. Proposals are developed for both structural and partial reforms of the fiscal system, focusing on tax measures that can be implemented in the medium or short term to boost a circular economy. More specifically, we suggest a complete redesign of the currently opaque and significant amount of tax expenditure to transform environmentally harmful tax benefits into environmentally friendly tax measures that are suitable for the circular economy.

Keywords: fiscal system; fiscal expenditure; tax benefits; circular economy; circular activities; circular taxation

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1. Introduction

The circular economy (CE) implies a radical change with respect to the current paradigm of linear production and consumption. It requires the development of circular business models (CBMs) in productive industries, along with productive activities that extend the useful life of goods and introduce subsequent changes to consumption patterns. This is intended to reduce the consumption of material resources and energy while also reducing waste and pollution.

In the effort to promote the transition to a circular production and consumption model, all policies must integrate sustainability principles. A policy mix should also be developed that combines industrial, regulatory, R&D, and innovation instruments with environmental, fiscal, and financial policies, public purchases, etc. Work is already underway to develop specific financial instruments and even monetary policy instruments. Within this policy-mix approach, we will focus specifically on fiscal policies. Because they affect prices, fiscal policies constitute a potentially effective structural instrument for guiding markets and the behaviour of economic agents. In fact, the extensive literature on environmental policy clearly advocates market instruments based on prices and taxes [1–15].

The rationale for conventional environmental taxation is optimal taxation theory. In this theory the principles of a "good tax system" are equity (vertical and horizontal), economic efficiency (does not distort the allocation of free market resources), and easy administration (management efficiency). "The social planner's goal is to choose the tax system that maximizes the representative consumer's welfare, knowing that the consumer will respond to whatever incentives the tax system provides. [. . .] Absent any market imperfection such as a pre-existing externality, it is best not to distort the choices of that consumer at all" [16] (pp. 148–149). This theory involves a narrow focus on individual consumer welfare and very unrealistic assumptions. It is very difficult, if not impossible, to calculate the taxes and rates that would be necessary to guarantee optimality in resource allocation and equity. On the contrary, it can be argued that any tax introduces a distortion in equity and allocation of resources [17] (pp. 265–283); the question is how much and in which direction.

It is within this optimal taxation rationale that environmental taxes are used as instruments to correct market failures derived from externalities that cause an inefficient allocation of resources. Pigou [18] was the first to formulate the relevance of taxes to internalize externalities as an ingredient of welfare economics. In this case, Pigouvian tax can increase efficiency and welfare and also raise revenue. In theory, Pigouvian taxes are considered to be pareto-efficient by equalizing tax and marginal costs; however, in reality, it is very difficult for this hypothesis to be fulfilled due to two main reasons: on the one hand, it is very difficult to calculate the economic value of externalities, and, on the other hand, in any case, it would be difficult to set a rate that can exactly compensate for these externalities [1,2]. In fact, the Baumol and Oates [1] and Baumol [2] proposal requires successive experimentation and an adjustment to the target levels, substituting a rational choice and maximizing framework for a bounded rationality and a satisfying one. Moreover, as "We do not know how to calculate the required taxes and subsidies and we do not know how to approximate them by trial and error [. . .] it is perfectly reasonable to act on the basis of a set of minimum standards of acceptability" [2] (p. 318). This means that environmental taxes are conceived as a combination of prices and standards, designed not to achieve a pareto-efficient allocation but to achieve a pre-set arbitrary environmental target. Furthermore, this detour from the theory of optimal taxation leads to a more pragmatic approach precisely because "the level of acceptable pollution is not a question of economics, but of environmental as well as of social (particularly intergenerational) justice considerations and can be set by the government" [19] (p. 275).

Over the last few decades, the implementation of environmental taxation has been focused on the correction of negative externalities and on the Pigouvian principle of forcing polluters to internalize the cost of their negative environmental impact as damage to the public good. Increasing the costs of production or consumption that we wish to discourage is the best instrument for encouraging changes in the behaviour of agents, which reduces this type of production or consumption and thereby reduces pollution [2]. Taxes on very specific activities or consumption that generate highly polluting emissions, effluents, or residues—especially energy taxes and the carbon tax—are the most widely studied environmental tax instruments [4–6,13,20–24]. A broader debate has revolved around carbon taxation. In fact, most OECD member countries have established this carbon tax based on agreements to reduce greenhouse gas (GHG) emissions and global warming (from the 1997 Kyoto Protocol or the Paris Summit on Climate Change).

More than 100 types of green taxes based on the "polluter pays" principle (carbon emissions, fossil fuels, waste, water, etc.) are currently in force, but this proliferation does not inherently lead to a significant impact on environmental performance [25] and [26] (p. 7) found that, "over the past 15 years, environmental taxes as a proportion of GDP have decreased in 52 of the 79 countries in the OECD database and, in addition to relatively low levels of environmental taxes, global fossil fuel subsidies increased to $373 billion by 2015". A recent joint study by the OECD, the World Bank, and the United Nations [27] (p. 22) acknowledged that, despite the progress of the last three decades, the global balance sheet remains openly unsatisfactory, and, accordingly, it is necessary to move "far beyond marginal or incremental changes in policies and behaviour".

The modest results of that first generation of environmental taxes paved the way for new proposals [4,25,26,28,29]. The three most salient reasons for the unsatisfactory outcome—or, rather, failure—of this first generation of environmental taxes are: (1) the promotion and proliferation of numerous, scarcely relevant taxes that (2) involve a limited portion of polluting activities and (3) apply very low tax rates. Indeed, through the influence of companies and interest groups, tax rates ended up being set so low that they were ineffective at reducing emissions [30] (p. 65); [28] (p. 358 and following). "The problem is in the economy: if the tax is too moderate, it fails to remove enough fossil fuel to help the climate; but if it is high enough to actually reduce it, then business and consumers resist the tax—because without some safety cushion for business and consumers, the whole problem falls on them and they rationally resist—to save profits and jobs" [30] (p. 360). From other perspectives (e.g., the Public Choice), the conundrum for an ambitious environmental policy (e.g., significant taxation) remains the voter's perceptions of the environmental objectives [31].

The modest results also stem from having too narrow a focus, leaving many other forms of pollution generation that impact the biosphere and the atmosphere untaxed. Along these lines, Rockström [32] and Raworth [33] have identified new planetary limits that are being seriously violated. High levels of solid and liquid waste and excessive use of natural resources alter terrestrial and marine ecosystems, water cycles, and other basic elements. These indirectly accelerate climate change by acting as pollutants that block photosynthesis and have other collateral effects on nature, human health, and the economy. Mitigating and preventing these multiple forms of pollution requires changes in public policy, particularly through taxation.

These extremely limited results, and the conviction that significant and urgent change is needed to address serious global environmental problems, necessitate more far-reaching tax changes, such as those formulated for the circular economy. To move beyond the narrow debate on standard environmental taxation, it is necessary to open up the debate on the very architecture of the tax system. The assumption here is that the transition towards the circular economy justifies a fiscal shift by significant changes in the main taxes (VAT, Corporation, Income . . .).

The existing taxation system penalizes labour-intensive activities, including many circular activities (e.g., repair, maintenance, reuse, recycling, and remediation services), in contrast with the resource-intensive activities of the linear economy or the (robotized) manufacture of new products. Waste and resource use could be significantly reduced by decreasing the consumption of new material and energy resources, increasing the offer and consumer demand for circular activities (e.g., reuse, repair, and maintenance) and, of course, recycling waste and returning it to the processing cycle. Undoubtedly, taxes (and subsidies) significantly affect the costs and prices of these activities [34–36]. According to Stahel [37], "a shift to a sustainable taxation constitutes a giant booster to multiply the benefits of a circular economy within a national economy".

Based on the hypothesis that taxes are a key element in altering the relative prices of goods and orienting demand, this paper attempts to systematize different possible levels of fiscal policy reform for a transition towards a circular economy. The literature on potential environmental tax reform focuses primarily on the energy problem and emissions, somewhat less on resources or waste, and very little on the tax regime for circular activities and models. Furthermore, some contributions to "circular taxation" are in fact limited to the introduction of measures and instruments to penalize or discourage waste generation [38–40]. However, the circular economy is a new productive paradigm that goes far beyond waste management or recycling. Accordingly, this research will review the main proposals for using the tax system as a key lever for promoting the transition to a circular economy by modifying the relative prices of goods and services to favour circular options, as described by authors writing on the ecological economy and the circular economy. Through a review of their literature, we can establish the basis of a tax system that encourages a circular rather than a linear economy.

This paper is structured as follows. After a critical assessment of the theory and reality of the current environmental taxation system, we develop inputs for a framework for CE taxation. In Section 2, the circular economy is presented conceptually as a new paradigm of production and consumption, emphasizing the relevance of both the reduction in material resources and energy consumption and the extension of the lifespan of goods. Section 3 describes two main types of CE taxation schemes, including a discussion of some critical aspects, flaws, and obstacles. Section 4 contains a feasible short-term proposal to boost the transition towards a circular economy, mainly focusing on shifting tax expenditure. Section 5 contains some final remarks, highlights the main general conclusions, and gives recommendations for future research.

2. The Circular Economy

The concept of the circular economy arose as a contrast to the linear economy: a predominantly resource- and energy-intensive industrial model based on an "extract–produce–use–strip" sequence. The linear economy responds to the capitalistic economic logic of unlimited growth of production and consumption that has driven the compulsive expansion of both in the last two centuries. The linear economy has been operating as if the planet had no ecological limits, neither in terms of resources nor in terms of impacts, but this model ends up being unsustainable for the biosphere and society itself [11,28,41].

The circular economy is a productive paradigm that emphasizes the regenerative capacity of the ecosystem, minimising the consumption of non-renewable resources, prolonging the useful life of goods, and reusing all materials that enter the economic cycle, to minimize waste and emissions [37,42–47]. According to Vence and Pereira [48] (p. 3), "the specific objective of the circular economy is to reduce the consumption of resources and energy and reduce waste through the perpetual return of resources within the economy. All resources incorporated into the economic cycle must be managed as permanent and renewable resources." Because the circular economy concept is a work in progress, no general consensus exists regarding its principles and scope. For example, Kirchherr et al. [49] studied 114 different definitions, codified into 17 dimensions. Conceptualizations depend on the degree of generality, the phase of the production–consumption chain on which the focus is placed, and the theoretical frame of reference, among other factors.

This great diversity of CE concepts can be organized into two major groups [46,50]. On the one hand are those that emphasize the long cycles of materials and molecules, focusing on the optimization of use, full recovery, and continuous reincorporation into the production cycle (what Stahel calls the "Era of D"). On the other hand are those that emphasize the short cycles of products and focus on extending their useful life and functionality (the "Era of R": Reuse, Repair, Remanufacture).

One representative version from the first group starts with the "Cradle to Cradle" (C2C) concept of McDonough and Braungart [51], which is articulated around three ideas or principles: (a) "Waste equals food": materials circulate in biological (organic, biodegradable) or technological cycles, which are never wasted in landfill or destroyed, but constantly reused; (b) "Respect for diversity": natural (biodiversity), cultural, or local forms of knowledge and production; and (c) Income from the use of solar energy and other forms of unlimited renewable energy (wind, kinetic, endomotive, etc.). The emphasis on materials goes far beyond use efficiency or recycling, which normally implies the degradation of material properties in downcycling. In fact, CE proponents tend to be critical of dominant approaches to sustainability that focus on optimization, eco-efficiency, waste, and recycling (official policies in the EU or China), because they reduce damage rather than eliminating it. The same applies to bioeconomics, which advocates burning organic resources as a "green" technique for limited energy use. In contrast to this approach, which is highly focused on recycling, the circular economy proposes production systems in which materials maintain their value and are constantly reused rather than degraded. The optimal way to achieve this is to keep the products containing those materials in use.

That is precisely what the second type of CE model emphasizes: prolonging the use of the entire stock of produced goods for as long as possible [47,50]. In this approach, "the Circular Industrial Economy [CIE] manages the stock of manufactured assets, such as infrastructures, buildings, vehicles, equipment and consumer goods to maintain their value and utility as long as possible; as regards resources, the CIE maintains the stock of these assets at its maximum level of purity and value. The CIE contrasts with the Linear IE [Industrial Economy] in that its objectives are based on maintaining value (not creating added value), on optimising stock management (not flows), and on increasing efficiency in the use of goods (and not in the production of goods)” [50] (p. 12). This shift towards a CE focused on stock management is based on three cycles. The first two constitute the “Era of R”: (i) the reuse and resale of goods; and (ii) activities to extend the life of the product or goods. The third cycle involves secondary resources or the recycling of molecules and corresponds to the “Era of D” (Figure 1).

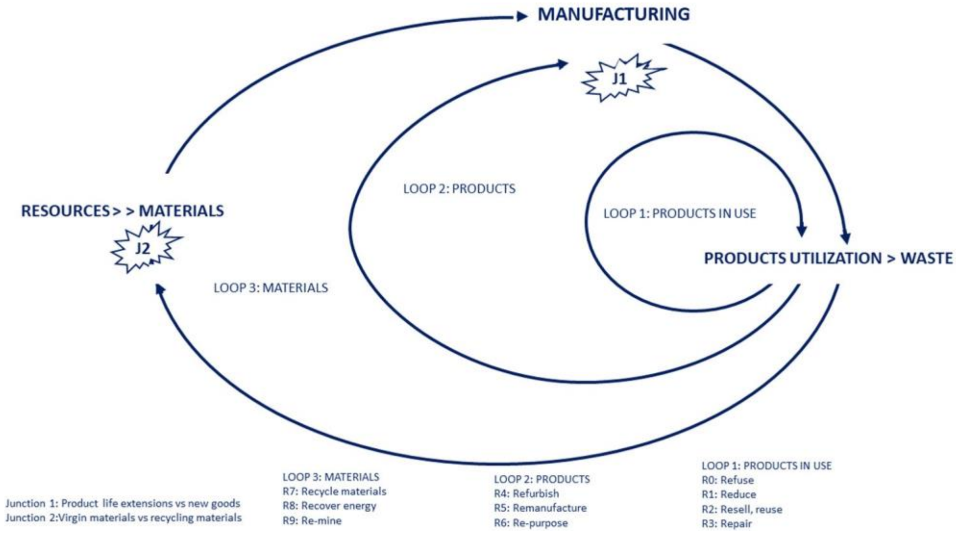

Figure 1. Scheme of the circular economy (based on [37,45]).

Economic factors play an essential role in the two main disjunctives between circular and linear economies. First, a choice must be made between extending the life of products and purchasing new products (Figure 1). In this case, the comparative advantage of used goods grows to the extent that labour costs decrease in relation to services and activities associated with goods’ life extension and the cost of virgin materials in manufactured goods increases. Second, a choice has to be made between recycled versus virgin materials. Here, taxation on non-renewable virgin resources makes recycling (reuse of molecules) a more viable activity. Furthermore, reducing or eliminating taxation on labour would make end-of-life waste collection and sorting cheaper, thereby increasing the quality of secondary resources. All this would lower costs and raise the quality of secondary (recycled) resources, thereby expanding their market.

The circular economy has clear environmental advantages and facilitates others that are equally important [37,50]. Using skilled human labour and creating jobs, especially at local levels, reinforces regional and local development dynamics. CE labour inputs are higher because the geography and volume of their economies of scale are limited and some activities, such as repair and remanufacturing, are labour intensive [46,52]. Consequently, nontaxation on labour would stimulate employment in all labour-intensive economic sectors, including those involving the care and use of local renewable resources: organic farming, fishing, production and repair of wooden furniture, wool, textiles, footwear, leather goods, etc. This would also create qualified employment opportunities linked to improving infrastructures and equipment based on earlier technologies. Such activities tend to be located closer to the consumer and are, therefore, more widely distributed [53].

Unlike approaches focused on waste recovery and recycling, the circular economy proposes production and material systems without a loss of value, in which goods are designed to last, reparability is facilitated, and materials are continuously reused rather than degraded. Encouraging reuse and repair of goods to maximize their life span is an important strategy that involves more than the consumer at the end of the chain. It must start with eco-design for durability (as opposed to programmed or induced obsolescence) and facilitate reparability. This is not a merely technical issue (technological or use-based obsolescence); it requires a complete reversal of the economic logic of linear industry, which aims to sell as many goods as possible and have them renewed and replaced as soon as possible (sociopsychological obsolescence). In fact, despite the rhetoric of sustainable resource management, recent studies indicate that product lifespans are in fact shrinking in many sectors [54].

From a systemic perspective, CE must reduce the actual ecological footprint to keep the economy within the physical limits or carrying capacity of the planet [32]. As summarized by Krysovatky et al. [55] (p. 140), any stable society must ensure that: "(a) the rate of resource utilization does not exceed the rate of regeneration; (b) the rate of resource consumption does not exceed the rate of implementation of renewable substitutes; (c) the emission of pollutants and accumulation of waste does not exceed the rate of their harmless absorption". Therefore, the scope extends beyond reducing impacts to redefining activities, processes, and behaviour according to natural cycles and reproduction needs.

Instruments for promoting this change of paradigm must clearly involve diverse policies and actions at all levels, to create a complex policy mix capable of altering the basic rules of the current economic model. Changes to the fiscal (tax) system, which we analyse here, are key.

3. Taxation for the Transition towards a Circular Economy

Tax policies have a key role to play in the transition to a CE, as they can affect relative prices. The tax system incorporates, implicitly or explicitly, extrafiscal objectives. It can create incentives and disincentives that guide the behaviour of businesses, consumers, and the public sector while also generating public resources for direct action by public administrations.

The first issue that emerges is what instruments and actions are possible within the tax system, along with their nature and scope. These may include partial and specific measures to modify existing taxes or tax expenditure schemes or to create new environmental taxes to cover gaps in the existing tax system. The architectural design of the tax system could also be altered by significantly modifying or replacing the main existing taxes (VAT, income, corporate, etc.), but it is hard to imagine that this could happen in the near future. Despite the broad consensus regarding the importance of fiscal instruments and the environmental taxes developed in recent decades, actual experience has led to growing dissatisfaction with the proliferation of new, relatively marginal environmental taxes, as implemented in many countries. This has led some researchers to call for a more thorough reform of these taxes and even a deeper reconsideration of the design of the entire tax system.

The rationale for a tax shift towards circular taxation is based on the concept of extrafiscality or extrafiscal taxation (taxation with extrafiscal purposes, e.g., "sin taxes"). This emphasizes that taxation is not limited to raising revenue for the public budget, but also pursues other objectives of an industrial, commercial, social, public health, or environmental nature [56]. Therefore, these objectives are not only established in the public spending programs but also in the determination of the characteristics of taxes and tax expenditure instruments; both have the capacity to influence consumption and production choices, investment capacity, and savings, as well as economic development and the transformation of economic and social structures [56–58]. For the purposes of this paper, we want to highlight the relevance of a particular type of extrafiscal taxation: tax expenditure instruments. These are targeted-oriented instruments, operationalized through taxes, not as a targeted increase in taxes but as targeted waivers in taxes. Tax expenditures are the "carrots" in the basket of the tax policy. They include instruments of fiscal incentives and benefits used to favour or stimulate certain sectors, economic activities, economic regions, or agents of the economy whose purpose serves higher economic, social, and sustainability policy objectives.

Within the ecological economy paradigm, different proposals to change the structure of the tax system were launched. Virtually all ecological tax reform proposals prescribe taxes on resources and energy extraction, while reducing labour taxation. The plan developed by Weizsäcker and Jesinghaus [59] would gradually increase energy taxes while reducing taxes on labour and business profits and eliminating all types of environmentally harmful subsidies and benefits. To neutralize feedback effects, Weizsäcker [60] proposed a tax on productivity increase associated with the extraction and use of raw materials, energy, and water. Daly et al. [61] proposed a tax on the increase in the value of land and natural resources and the elimination of business income tax. Daly [41] proposed an ecological tax reform that would change the tax base from the current value-added taxes (on labour and capital) to taxes on resource extraction and pollution. Robertson [62] proposed a tax on the value of land and another on energy production from fossil and nuclear sources while eliminating taxes on income, profits, and VAT. Hawken [63] proposed gradually replacing income and payroll taxes with green taxes on pollution, environmental degradation, and the consumption of non-renewable energy. Paleocrassas [64] proposed a tax on resource extraction and a progressive shift towards a basket of green taxes, including reducing taxes on labour, income, and VAT. Costanza et al. [65] proposed a tax on the reduction of natural capital; Cato [66] proposed taxes on waste, transport, resource extraction at source, carbon, pesticides, etc. Busby and Cato [67] proposed the creation of a Base 1 Planetary Impact Index by which each company would multiply its current taxes. Raworth [33] advocated a Georgian-type land value tax, a tax on non-renewable sources, and property taxes in exchange for reducing taxes on labour and income in general, combined with subsidies for renewable energy and investment in the efficient use of resources. Presently, these proposals remain theoretical outlines, with no development towards implementation.

The emergence of the CE approach could be an opportunity to renew this debate. Notwithstanding, analysis of taxation remains incipient in perspectives that envision the circular economy as an alternative productive paradigm. Some proposals for structural tax reform that align with ecological economy ideas have emerged in the last few years. They start with the idea that the current tax system functions according to the linear capitalist economy paradigm; moreover, the current tax regime reinforces the linear character of the economy [37]. Thus, to shift towards a CE, costs and prices must be positively and negatively influenced to reorient production and consumption decisions in an environmentally responsible direction that benefits society and the economy. To achieve this, structural changes must be applied to the architecture of the current tax system.

What distinguishes ecological and circular taxation from current environmental taxation is that the first aims to go beyond putting a patch on the problem by "correcting" a specific market failure or a certain type of pollution. Rather, it advocates a comprehensive overhaul of the taxation system. The general idea is to modify or eliminate current taxes that imply costs for circular (and renewable) activities, reinforce taxes on non-renewable resources and capital (intensive activities in the linear economy), and eliminate the current benefits and subsidies for environmentally adverse activities. Conventional environmental taxation is considered insufficient because it focuses on taxing the harmful consumption of specific products at the end of the production chain. This overlooks many externalities such as resource extraction and depletion, increasing amount of all kinds of waste, water and air pollution, biodiversity, etc.

Two scenarios are described below, along with proposals for ambitious changes in the tax system towards environmental sustainability and a circular economy. We will focus on a critical assessment of two comprehensive proposals, the first formulated by Beeks and Lambert [68], and the second formulated by Stahel [37], The Ex'tax Project for the Netherlands [69], The Ex'tax Project for Europe [70], and Barret and Makale for New Zealand [71]. In Section 4, we discuss a short-term scenario and suggest a feasible short-term proposal.

3.1. Integral Reform of the Tax System with Proposals That Cover All Externalities

The most general and holistic proposal was developed by Beeks and Lambert [68] (2018). In this scenario, fiscal instruments influence market forces by inducing broad, crosscutting, socio-environmentally positive changes in production and consumption. Thus, it is not about correcting the most serious single impacts but transforming the entire economic system [11].

Beeks and Lambert [68] argue that negative externalities will be produced as long as they are economically viable. They will inevitably be transmitted to current and future societies in the absence of government actions capable of counteracting them. One way to reduce these externalities involves acting through market mechanisms—prices, in particular—to decrease associated profitability. For the authors, the objective is not only to transfer certain externalities to prices in accordance with a cost–benefit criterion—as mainstream environmental economics does—but also to design a comprehensive pricing system that incorporates sufficient incentives to change the behaviour of economic agents towards sustainable patterns. They explicitly agree with Daly [41] that reducing consumption-related impact may be the best way to reorient the current economic system, which is based on hyper-consumption and works by appropriating the natural (free) system, negatively affecting humanity and the economy itself. To do so, Beeks and Lambert [68] (p. 7) proposed estimating a new cost factor for all services and products, which would integrate all externalities generated in production and consumption. The aim is to fully cover all negative and positive externalities by means of an externality factors (EF) system. These would include estimates for not only CO_2 and GHG emissions, but also all pollutants affecting water, the atmosphere, soil, biodiversity, the ecological system, and human well-being.

Rather than designing or assessing single taxes to correct a specific externality, this proposal involves creating a tax system that attempts to counteract the combined sum of the various externalities. Another novel element is that it adds on the estimated cost of negative externalities and discounts positive externalities, so that the external factor added to the price of the good reflects the balance of them all. Using market forces, the EF system would raise the selling price to discourage negative production and consumption or reduce it to encourage positive production and consumption. The important thing here is that the tax system itself (taxes, subsidies, benefits) promotes a transition to environmentally friendly and safe practices.

Calculating externalities precisely is one of the first difficulties to overcome when defining and implementing such a tax. This complexity has always invited critique, especially by those who doctrinally defend the need for optimum taxes in which the amount tax corresponds exactly to the value of the externality. However, the authors suggest moving on from this limiting debate: precise calculation of externalities or setting the tax at an amount that exactly compensates the calculated externalities is not the most important issue. Rather, a reference estimate can be used to determine—through a policy process—the amount of tax. This pragmatic proposal assumes that taxation is not strictly or exclusively a technical matter. The important thing is the willingness to account for socio-environmental costs (negative externalities) that are not currently included in corporate calculations of the cost of goods and understanding the specific configuration and determination of the tax as part of a sociopolitical and institutional decision-making process. Governments, on the basis of dialogue with social agents, must then work out the specifics of tax design and amount. In fact, these authors assume that such discretion may lead to diverse taxes on the same goods in different countries or territories.

Below, we summarize the key elements and prevailing logic for EFS configuration from Beeks and Lambert [68] (pp. 2–10):

A. Limited rationality versus optimality. In line with what has been proposed by Martínez Alier [11,72], Daly [41] and Hawken [63], Beeks and Lambert [68] consider that the important thing is the decision to tax externalities, accepting limited rationality and approximation over obsession with precision and optimality. It is generally accepted that determining the cost of externalities "is neither practical nor possible" [11] but that "trying to measure negative costs is preferable to ignoring them completely, that it is better to be approximately right than completely wrong" [63] (p. 101). Accordingly, it is acceptable and advisable to "tax polluting activities, resource extraction and resource depletion, all without connecting the precise cost of these activities to the tax" [41] (p. 4). The key is to accept a commitment to a "cost approach" that enables tentative and evolutionary means of addressing pervasive problems such as natural impacts. In other words, an estimated or approximated tax would suffice to reduce the gap between the private and socio-environmental costs of the objective it seeks to influence.

The tax essentially imposes a non-negotiable price that will bring about the desired results of less pollution, healthier ecosystems, and less use of natural resources, while generating equity and revenue. Benefits and subsidies can then be directed towards environmentally positive activities.

B. The price must be able to influence the behaviour of consumers and producers towards positive, long-term change. First, it would be reasonable and timely to set the tax rate low and eventually increase it, to internalize costs as fully as possible. The system should be flexible enough to allow for tax adjustments on goods with high or low externalities.
C. Ideally, high taxes would be applied to obviously "harmful" goods and services, though attention should be given to the effects of these cost increases on the price index and, hence, on the economy (e.g., inflation). Even so, it would be reasonable to set comparatively high taxes on these "harmful" goods in the short term, to discourage consumption. The intent is to affect the entire cost dimension, penalising or incentivising with taxes and benefits (and subsidies). Economic agents who make a positive effort will benefit economically from tax reductions and possible support for sustainable investments.
D. General coverage that reflects all implicit and explicit externalities. The point of the proposal is to integrate all categories of externalities, trying to assess the damage in a multidimensional way: "the EF system is intended to take into account production externalities, consumption externalities, monetary and non-monetary externalities, and whether they are positive or negative" [68] (p. 7). To achieve this, seven categories are proposed for the general coverage of externalities, especially negative ones: 1. air pollution; 2. water pollution; 3. soil (earth) pollution; 4. impact on the ecological system; 5. impact on human and animal welfare; 6. social and cultural impact; 7. contribution to global climate change. All categories are included in the final cost assessment.

All these negative impacts will be accounted for throughout the production chain. This includes extraction, refining, processing, transport, distribution, and the potential effects (including damage) of the whole process up to the time of purchase. It even incorporates the location of the production system and the logistics line used. Thus, proximity to production would imply lower costs because the incidence of externalities would obviously be lower (in absolute terms).

E. Application of the externality factor system (EFS) involves estimating the value of each category of externalities for each product, finding the balance between negative and positive ones for each category and adding it to the standard cost. Each balance of negative and positive externalities would be placed on a base 1 scale, with a conventional range of variation from 0.8 for those with a more positive balance to 1.3 for those with a more negative balance (as suggested by the authors [68] (p. 9). Multiplying by values below 1 implies a reduction in cost, while multiplying by values above 1 would increase the cost. Multiplying the standard production cost by each of the seven externality factors (for each category) gives us the final cost of each product. The difference between the standard cost and the final cost is the total externality factor cost, which can be positive or negative depending on whether negative or positive externalities predominate. Thus, the cost of a good or service at final sale results from the cumulative effect of the combination and application of all EF categories. In such a situation, a lower EF cost implies a benefit for the retailer—as a form of "subsidy"—and a higher EF cost signifies higher penalties.

Introducing this cost factor to reflect externalities is intended to influence consumption by significantly altering the price of goods and services. Unlike traditional environmental taxation that addresses specific externalities, this proposal assumes that externalities are everywhere and, accordingly, we should adjust the tax system to consider all externalities arising from economic activity in all sectors. It is worth noting that the cost/value of each externality factor is not calculated precisely with an optimality criterion, according to some cost–benefit analyses, but that its determination involves a social and political decision. Therefore, considering the social circumstances and preferences (e.g., aiming to limit global warming to 1.5 °C instead of 2 °C), the expected positive effects should include reduced goods consumption; changes in demand and lifestyles (less harmful to the environment); changes in industrial production, such as improving development and technological innovation to reduce pollution, substituting raw materials, reusing products and materials, extending the life of goods, etc.

3.2. Integral Tax Reform Based on Taxation of Natural Resources and Reduction of Labour Taxes

A second type of proposal to design a new and sustainable tax system for a circular economy prioritizes taxes on non-renewable resources, eliminating subsidies to polluting sectors and reducing or eliminating taxation of renewable resources (including labour, which is considered the most renewable resource). Along these lines, Stahel [67] introduced a pioneering scheme that has been developed with adaptations to the specific circumstances of certain countries. Examples include [69,70,73,74]. Milios [36] provides an interesting review of raw material tax, repairing, and the hierarchy of waste.

The basic idea is that the actual tax system inhibits the emergence of a sustainable CE and taxation is essential to facilitating the emergence and expansion of circular activities. Because taxation is a key instrument for altering market forces and prices, it can influence all stages of the chain, from innovation to design and manufacturing patterns to consumption.

As Stahel [50] argues, "the linear economy is resource and capital intensive, while the circular economy is labour intensive. Current fiscal policies in many countries impose heavy taxes on labour, while subsidizing the production and consumption of fossil fuels and other non-renewable resources. Reversing taxes on these two factors of production, favouring renewable resources over non-renewable ones, would give economic agents direct incentives to change towards the circular economy and sustainability" (p. 72). With similar proposals, Raworth [33] (p. 164) insists that the shift "from taxing labour to using non-renewable resources [. . .] would help erode the unfair tax advantages currently given to companies investing in machines (a tax deduction rather than in humans (a payroll spend)".

The objective of the EC and the new form of taxation would be not so much to increase efficiency as, above all, to promote goods and consumption that do not alter environmental capacity. It emphasizes eco-design, reduction, repair (and maintenance), remanufacture, and reuse of items related to consumption and production, to avoid waste generation and the consumption of new non-renewable resources.

The implementation of sustainable, pro-circular taxation can have favourable effects on the different cycles. Figure 1, based on Stahel [37], lists the foreseeable impacts of sustainable taxation on material and resource sufficiency and efficiency, which are summarized as follows:

(a) Taxation on non-renewable resources is an incentive to minimize resource consumption, by-products of production, and waste. Water and energy savings, together with waste prevention, become profitable activities, especially if resource prices increase continuously.

(b) At Junction 1 (J1), nontaxation on labour favours reuse, repair, and remanufacturing activities. The regional nature of the circular economy, compared to global manufacturing chains, significantly reduces the energy involved in transport.

(c) At Junction 2 (J2), many materials used today are more expensive than virgin materials. Sustainable taxation favours labour-intensive approaches to high quality, lowering the labour cost of sorting used material while increasing the price of non-renewable virgin materials.

(d) It should also create virtuous cycles for more efficient use of materials, saving money and thereby reducing material-intensive consumption.

These approaches can be developed for application in specific countries, such as [69,70,73]. The guiding ideas for The Ex'tax Project proposal are to change the tax system by taxing natural resources, to eliminate environmentally harmful subsidies, and to reduce labour taxes (see Table 1). Its most outstanding contribution involves efforts to create a toolkit of instruments and measures adapted to the fiscal reality of each country, starting with the full range of existing taxes and all available quantitative measures (rates, deductions, exemptions, allowances, subsidies, etc.).

Table 1. The panorama for change in the current architecture of the tax system.

(-) Labour Taxes	**(+) Resources Taxes**
	Challenges
Disentangling the (generalized) dependence on public income through labour taxes. Resisting robotic and computerized technology that replaces human capital. Inhibiting companies from seeking lower tax burdens in other jurisdictions.	- The use of primary resources should no longer be tax-free. - Reduce consumption of water, materials, harmful energy, etc. - Mitigate climate change. - Improve ecological footprint conditions. - Limit pollution, reduce residues and waste. - Make sustainable practices the most profitable.
	Opportunities
Human resources—as a cost factor—become more affordable. By favouring labour-intensive models, others may migrate towards them.	- When costs of NRs increase, efficiency in the use of NRs improves. - Increased "closed-cycle" activities or those that apply renewable materials.
	Advantages
Positive effects on GDP and employment Complies with the principle of tax neutrality In the first phase of the Green Tax Reform experience (1990s onwards) there was a positive effect on economic activity and employment.	- Environmental improvement. - Polluters must bear the cost of environmental impacts. - There is some acceptance by the business sector of this change.
	Barriers
Political commitments Absence of international coordination A desire for economic stability from labour tax revenues The benefits of reducing labour taxes in the past have not been highlighted. An interdisciplinary approach is needed.	

Source: Prepared by the authors, based on [69].

The proposal to reduce labour-related taxes and replace them with natural resource taxes takes the whole range of tax bases into account. The first group includes taxes that burden human effort (income tax, social contributions, corporate income tax, VAT), to which actions involving rates, deductions, exemptions, allowances, and subsidies can be applied. The second group includes taxes related to the destruction of natural resources, such as air pollution, building materials, ecosystem services, energy, food production, fossil fuels, metals and minerals, traffic (air freight, road transport, air traffic, plane tickets, maritime transport, traffic congestion, road traffic), waste, various other resources, and VAT. Within these 12 families of taxes on non-renewables (NR), there are up to 104 taxable assumptions or subcategories [69].

This comprehensive "toolkit" allows policymakers to combine, time, and prioritize measures according to their urgency, degree of short-term feasibility, potential benefits, and accessibility. Because it is flexible, it can adapt to the changing needs of public systems. Adequate management of the toolkit can facilitate a path that reduces labour taxes and increases resource taxes according to the principle of neutrality.

To summarize, this proposal starts with the current configuration of the existing tax system in each country. It then offers an entire battery of changes that constitute a complex toolkit. The options range from creating new taxes on the use and consumption of non-renewable resources to easing the burden on circular activities by changing existing taxes to reducing existing tax benefits for environmentally harmful activities.

3.3. Discussion

3.3.1. Circular Taxation as an Alternative to Environmental Taxation

Comparatively, we can affirm that the objectives of circular economy taxation are more ambitious than those of environmental taxation in recent decades. In range and reach, they far exceed policies involving small, super specific environmental taxes or the green tax par excellence: the carbon tax. Existing environmental taxes aim to reduce some externalities and give small impulses to change economic behaviour, but they leave the basic structure of the linear economy intact. On the contrary, circular taxation aims to contribute to a more radical change in the economic structure, significantly altering relative prices and changing the behaviour of firms and consumers to achieve an economy that respects the limits of the planet.

Based on a preliminary contribution by [71], we have identified five main differences between circular and environmental taxation, which are summarized in Table 2. They involve (a) the recalibration of existing environmental taxes to incorporate the real prices of externalities and bring about effective change in the behaviour of economic agents, production, and consumption; (b) encouraging extension of the useful life of goods as much as possible (taking into account the whole chain from design to consumption, repair, and reuse); (c) encouraging recycling (cradle to cradle) in a fundamental way; (d) moving from taxes on labour to taxes on the use of resources; and (e) greater use of the concepts of merit and demerit to push consumers towards the desired behaviour.

Table 2. Differences in the objectives and characteristics of environmental and circular taxation.

Objectives of Taxation	Current Environmental Taxation	Circular Economy Tax System
1. Correcting externalities or mispricing. 2. Reducing pollution and carbon emissions. 3. Subsidising sustainable practices. 4. Signalling resource scarcity. 5. Using the land most efficiently.	1. Relative correction of some externalities. 2. Low-pricing pollution and carbon emissions. 3. Some subsidies for sustainable practices are counterbalanced by others. 4. Insufficient signalling of resources scarcity. 5. Flat tax rate does not disincentivize greater land use.	1. Recalibrate existing environmental taxes to proxy the real prices of externalities. 2. Flexible taxation based on scientific and policy targets (e.g., 1.5 °C warming). 3. Extensive use of benefits to incentivize extending the useful life of goods and recycling. 4. Shift from taxes on labour to taxes on the use of non-renewable resources. 5. Comprehensive taxation of land to promote optimal use.

Source: Prepared by the authors..

3.3.2. Potential Effects of Circular Taxation and Necessary Precautions

Having identified the characteristics of circular taxation, we move on to the expected effects and consequences. Among those indicated by the authors of the proposals themselves, circular taxation would: (a) accelerate the transformation from a current economy focused on "flow optimization" (the essential logic of national accounting and GDP) to an economy focused on "stock optimization"; (b) expand the circular economy to new economic actors and sectors; (c) increase the competitive advantage of existing economic actors in the circular economy; (d) by not taxing renewable resources (including labour), it contribute to greater resource security, job creation, and lower GHG emissions; and (e) strengthen regional distribution and social cohesion.

Circular taxation reinforces the incentives to boost eco-innovation in all sectors, increase optimization in the use of resources and energy, look for new eco-materials, reuse/recycle materials, and develop innovations for eco-design, long-lasting products, and reparability [48,71]. Of course, specific tax measures could be adopted into the schemes of R&D tax policy in order to enhance and prioritize eco-innovation and eco-R&D.

Not taxing labour increases the competitiveness of labour-intensive activities of the regional circular economy compared with the global industrial manufacturing; regional activities mean lower transport volumes and shorter transport distances in the processing chain. Applying the principles of sustainability to the economy means decoupling wealth and welfare (stock) from resource consumption (flow). A shift in taxation from renewable resources, including work, to non-renewable ones will boost regional job creation, employment, and occupation of all forms in labour-intensive industrial and service sectors [37] (p. 16).

Therefore, a change towards CE would bring about environmental benefits and positive economic impact. Estimates from 2016 based on Cambridge Econometrics Models [70] showed that shifting 554 billion euros of taxes from labour to pollution and resource use in the European Union would allow 6.6 million more people to be employed, reduce carbon emissions by 8.2% by 2020, and save 27.7 billion euros on energy imports over a five-year period.

Having pointed out the potential virtues of reducing labour-related taxes to favour the development of circular activities, which are generally labour-intensive [52], it is necessary to acknowledge some risks. A drastic and immediate decrease in labour-related taxes could have unforeseen consequences, especially in countries with a weak tax base, or where current public revenues are highly dependent on certain taxes, or where social benefits (pensions, health services, etc.) are basically financed by social contributions [11] (p. 173). Any change in the tax system towards environmental sustainability must guarantee social sustainability by ensuring progressivity and sufficient revenue to maintain essential welfare state services. Of course, this is a key issue that requires extensive research in the future.

When formulating a general, transversal tax system for all types of consumption, unexpected or undesired problems and effects may arise (such as inequalities or poverty) that will require corrective or compensatory measures. One potential problem is that it is a broad-based indirect tax scheme, in which a higher level of pollution is attributed a higher value (EF) over cost. Given the general experience with such taxes (VAT, for example), citizens at the lower end of the income distribution scale may experience a regressive effect when it comes to meeting their consumption needs.

To address this, Beeks and Lambert [68] introduced some factors that can be used to reduce the regressive effect that normally accompanies environmental taxes (such as excise taxes). One of these, the "social and cultural impacts" factor, can take social and distributive effects into account, so that the overall effect of the tax is inclusive and favourable to social cohesion. To this end, the authors suggest that "it will be necessary to cap out the highest EF tax initially for most necessary goods in order to protect low-income consumers from the higher costs of essential goods" [68] (p. 14).

Furthermore, because this system affects all phases of production, consumers can opt for more local consumption, which normally incurs fewer negative externalities, or use collective and public services to avoid high consumption and choose savings. To encourage more sustainable practices, these authors propose that this tax system not be applied uniformly to a product or activity sector but calculated at a micro level, according to the characteristics of the productive process of each company.

Importantly, even though EFs are assigned to goods and services either at the point of retail sale or at different points in the supply chain, they can be adjusted depending on the practices of a given retailer, distributor, wholesaler, and/or producer. As an example, if a firm depends too heavily on the worldwide shipment of goods, participates in deforestation activities because of the goods they purchase, has inefficient and unsustainable practices, or is known to rely on unsafe working conditions for the production of goods, among other things, then the EFs can be increased specifically for this firm. Therefore, another firm purchasing the exact same goods that does not use excessive amounts of fossil fuel for shipping, does not purchase goods that lead to deforestation activities, and does not purchase from factories with unsafe working conditions may be assigned lower EFs for the same product [68] (p. 10).

Finally, beyond the inevitable complexity, it is necessary to point out some weaknesses that require reconsideration. Firstly, calculating externalities and EF at the company level introduces unwieldy complexity and a potential source of fraud. Moreover, this predilection for micro-level differentiation, as opposed to setting standards by product or sector, is likely to contribute relatively little to the objectives. The complex calculation system poses a cumbersome challenge for public finances and companies. Given that companies would be tasked with implementing this EF system in which multiple externalities are calculated and reflected in the price of each product, a rigorous control and computer data system would have to be activated, with modern programming systems and algorithms supported by Artificial Intelligence, control and compliance audits, etc. Permanent monitoring at macro and micro levels has also been suggested, with special attention to inflation aspects.

This degree of individualization introduces many random or arbitrary factors that would invite distortion of company calculations for certain externalities, to reduce taxation or increase competitiveness (possible dumping issues). To avoid this, it would be necessary to strengthen the partnership between the private and public sectors [68] (p. 13). This would require public financing, along with the appropriate instruments for inspection and control.

Secondly, the suggested price adjustment range of −20% to +30% means that the actual tax is relatively low and does not sufficiently penalize the most serious consumption.

Thirdly, balancing and offsetting prices transfers the desired effect to the consumer. The resulting tax revenues may be too low, which could severely reduce public revenue, the financing of basic state functions, or resources for welfare and environmental investment policies. Moreover, it is not clear from the proposal what part of the EFS revenue goes to the government. In fact, the authors mention other changes to the tax system such as gradual reduction of income and more active use of land and property taxes, along the lines of "Georgian taxes", which were proposed by the American economist Henry George [75]. This would cover possible drops in collection or correct undesirable consequences in the distribution of tax burdens among people or territories [68] (p. 14).

3.3.3. Challenges and Barriers to Circular Taxation

The transition to a circular economy involves extensive systemic change that alters the features of the economic–productive model and the basic rules of the game, including determinants of value, social priorities, and the choices of individuals. The relative prices of goods and services must be modified to orient economic activities and consumption towards those that are less intensive in natural resources and non-renewable energy. The tax system is a powerful instrument in this arena. It can affect the profitability of activities, thereby altering investor behaviour and the relative prices of goods and services, which can change consumer consumption patterns.

It is increasingly evident that the inherited fiscal architecture reinforces an unsustainable economic model. Therefore, changing the architecture of the tax system—rather than specific areas or individual taxes—is central to creating framework conditions for the transition to a circular economy and sustainability throughout the economic system.

Despite the advantages it would bring, there are numerous obstacles that slow progress in a change of this magnitude. First, it would require strong social and political consensus and a relatively stable long-term transition strategy that can withstand clashes stemming from relatively short policy cycles. Second, breaking fiscal habits is difficult, especially if it means paying for something that was previously not taxed. Third, industries with vested interests often form powerful lobbies for change, with significantly greater force and voice than other interest groups, such as nongovernmental organizations (NGOs), health organizations, or small and medium-sized enterprises interested in transition [31]. Fourth, a change in the tax architecture requires some international coordination in the design and pace of implementing tax reform. Finally, fiscal change on this scale modifies essential characteristics of the current economic model and globalization dynamics. Changing financial incentives will change trade patterns, financial flows, and development strategies in many countries.

4. Short-Term Feasible Tax Reforms for Circular Transition

Since a radical and comprehensive change of this magnitude is unlikely to occur in the short term, it may be more effective to think of a sequence of target-oriented changes for the transition to CE. A correct sequencing of the change is crucial to achieve safe progress. Being aware of the difficulties in moving towards a change in the architecture of the tax model as proposed, it is advisable to explore more easily traversable paths which, although more modest, move in the direction of circular taxation and can be implemented in the short term. The strategy we suggest here tries to take advantage of the existing weaknesses in the current fiscal model and focuses on a radical change in the tax expenditure schemes.

As mentioned before, tax expenditure is a particular type of extrafiscal taxation. It is a target-oriented instrument operationalized through taxes, not as a targeted increase in taxes but as a targeted waiver in taxes. Tax expenditures are the "carrots" in the basket of the tax policy. Since Surrey's seminal contribution to the topic, which considered tax expenditures and direct expenditures as equivalent [76,77], new work on the nature and applications of different tax expenditure instruments has been emerging. According to Villela, Lemgruber, and Jorrat [78] (p. 2), ECLAC/Oxfam [58] (p. 118), and Ashiabor [79], tax expenditures are instruments of fiscal incentives and benefits used to favour or stimulate certain sectors, economic activities, economic regions, or agents of the economy whose purpose serves higher economic, social, and sustainability policy objectives. "Both tax (expenditure) as well as direct expenditures serve programmatic objectives, as they have an economic and social purpose. With tax expenditure, a government forgoes tax revenues to subsidize various social and economic activities [. . .] One of the many features that set tax expenditures apart from direct expenditures is that unlike the latter, the former invariably involves the transfer of money by lowering an individual's or corporation's taxes [. . .] Tax expenditures are rarely subjected to the same annual appropriations process as direct expenditure. Their true fiscal cost is hidden as revenue forgone...even if analysed, can sometimes be difficult to estimate" [79] (pp. 22–23).

In real tax policy, tax expenditure has been an increasingly used instrument since the 1980s. Tax expenditure is currently a big black hole in the taxation of almost all countries. The debatable issue is the specific direction, beneficiary agents, and effects of the measures that have been implemented over the years. Although tax benefits have been adopted for environmental purposes, the vast majority of them serve other objectives.

Tax expenditure (tax benefits) materializes into governments' fiscal waivers [58,79,80], which can be granted to economic agents in diverse ways (incentives, tax relief, deductions, accelerated depreciation, etc.). Tax expenditure includes both incentives and benefits that affect consumption and investments that favour the environment or reduce environmental impacts and, on the opposite side, fiscal measures promoting productive activities and consumption practices with clearly unsustainable components that contradict the objectives of environmental policy (incentives for diesel and fuel consumption, which generate CO_2 emissions, or benefits for resource-extractive industries and the consumption of materials, etc.). What is striking is that the environmentally harmful subsidies (EHS) turn out to be much more important than the pro-environmental ones [58,79,81]

Due to the extensive usage of tax expenditure in the current tax regimes, we suggest focusing on these categories to pave the way for a transition towards a circular taxation system. Although this is an opaque and little studied subject, existing estimates place tax expenditure at 14–24% of total revenue in most countries, in some cases (e.g., the USA and the UK) exceeding 30%; as a proportion of GDP, the available estimation ranges from 3.7% in the Latin American countries to 8% in the USA [58] (p. 6); [81]. Moreover, only a very small part of it responds to environmental criteria and the vast majority benefits environmentally damaging activities [79,81]. For example, the 2018 tax expenditure in Mexico amounts to 20.7% of total revenue (3.24% of GDP), whereas environmental benefits account for only 0.07% of total revenue and the vast majority are not environmentally friendly; about 1.66% of total revenue is waivers, most of which are harmful to the environment (see Table 3). As an example, the full benefit (tax 0 rate) on VAT for repair and maintenance activities in Mexico would have a fiscal cost of only 0.71% of total revenue [82].

Table 3. Tax revenues and environmentally friendly versus environmentally harmful tax expenditure in Mexico in 2018.

Taxes	Revenue as % of GDP	Tax Benefits as % of Total Revenue	Environmental Tax Benefits as % of Revenue
Corporate income tax	3.7	3.9	0.07
Personal income tax	3.4	5.8	0.0
VAT	3.7	9.5	0.0
Special tax on production and services	1.7	1.5	0.0
Other	3.1	0	0.0
Total	15.6	20.70	0.07

Source: Prepared by the authors, based on [83].

Consequently, there is ample scope in all countries (14–40% of total revenues, without a tax burden increase) for changing the priorities and relative prices of different activities, goods, and services to induce changes favourable to the circular economy and sustainability, simply by eliminating environmentally harmful tax expenditure or introducing tax benefits for circular activities.

In recent years, some countries have formulated ambitious strategies (e.g., the European Green Deal) to encourage the transition towards a circular economy. In moving towards a circular economy, the first steps should focus on ambitious reform and make use of available tax expenditure measures, including the many tax benefits, exemptions, deductions, and allowances applicable to existing large taxes (e.g., VAT, Corporate Tax, etc.). As mentioned earlier, these instruments have been acquiring enormous presence in the general tax policy (mainly for non-environmental purposes) and, to a very modest extent, in environmental policies [79]. Therefore, if the political will exists, there is an opportunity to transform many discredited anti-environmental fiscal benefits into tax benefits that favour the promotion of circular activities and circular business models that prolong the life of products and reduce the consumption of natural resources and energy.

Feasible changes could be implemented in the short term by significantly altering the overly broad and opaque tax expenditure schemes in different ways, primarily focusing on good and service taxes, complemented by a reinforcement of taxes on non-renewable resources.

A. Application of VAT exemption or zero rate to encourage circular activities extending the life span of products and materials such as reuse, repair, remanufacturing, recycling, or remediation; minimum VAT should be applied to building rehabilitation and regeneration activities, etc. It is worth noting that the suggested measures are far more far-reaching than the tax relief on repairs introduced in a very limited way in some countries and, precisely for that reason, have not produced the expected results [35,36,84]. Of course, an assessment of the environmental benefits and the estimated fiscal cost should be made. In any case, this fiscal cost can be neutralized by the elimination of other anti-environmental tax benefits.

B. The accelerated elimination of tax benefits and subsidies that are harmful to the environment or that protect and promote polluting, unsustainable, and noncircular activities (especially tax benefits for energy taxes, corporate taxes, and VAT).

C. These first steps towards CE would be reinforced by measures to significantly increase effective taxation along the life-cycle stages, in particular of non-renewable resources, non-renewable energy and GHGs, and waste hierarchy tax. Evaluation of recent experiences in Sweden suggests that applying such individual instruments with moderate ambition may limit their effectiveness [36]. To exploit their potential, it is necessary to combine the different instruments to substantially increase the tax base by broadening the degree of coverage of resources, activities, and consumption and by increasing the respective tax rates. In particular, tax on non-renewable resources should be combined with tax benefits on reuse, repair, remanufacturing, and improved recycling to induce a significant change in relative prices and incentivize circular consumption, replacing the purchase of new products by extending the life of existing products.

D. The allocation of carbon credits for activities that contribute to the prevention of GHG emissions and not only to their reduction. Avoiding emissions merits greater tax benefits than those granted for reducing emissions (but continuing to emit), as is currently the case. This essentially rewards existing polluters when they choose to reduce pollution rather than rewarding those who avoid pollution in the first place.

E. Although Stahel [37] (pp. 15–16) considers that the CE does not need subsidies, from our point of view, certain transitional and temporary subsidies could be justified as a way of pushing forward new CE business models and correcting the negative effects of the current fiscal system or power imbalances in the markets (oligopolies, dominance of big companies in linear sectors like commodities, the car industry, fast fashion, etc.).

5. Conclusions

There is a broad consensus regarding the importance of fiscal policy and the tax system as a fundamental tool for promoting transformations aimed at meeting environmental challenges. However, the proliferation of new, specific, and relatively marginal taxes with environmental objectives is proving to be a failure. Their modest results have fallen far short of expectations and fail to mitigate the serious environmental problems affecting the planet and society today. Furthermore, the capacity to even collect these taxes has decreased over the years.

It is increasingly evident that the inherited fiscal architecture of the past reinforces the unsustainability of the linear economic model. The transition towards a circular economy implies systemic changes that affect all aspects of economic life and require implementation of a policy mix that integrates a wide range of policies and instruments. The question is, what kind of changes in the tax system can effectively contribute to this transition? Systemic change towards CE must be accompanied by systemic change in the architecture of the tax system. However, here we suggest the need for a strategic roadmap that sets out a sequence of gradual, step-by-step changes that allow for major but feasible changes in the short term, clearly oriented to the objectives of long-term architectural change.

The strategic proposal, which can be implemented in the medium to long term, is based on the idea of prioritising taxes on non-renewable resources ("Georgian taxes") and eliminating or reducing the tax on renewable resources (including labour, which is considered the most renewable resource). Alternatively, a general and transversal tax could be created that reflects the combined value of all the externalities associated with each product or the chain of activities involved in its production, from the extraction of the raw material to consumption. Favourable tax treatment of renewable versus non-renewable resources would change relative prices in favour of the former, giving economic agents direct incentives to change towards a circular economy and sustainability. This radical shift towards circularity in the fiscal architecture would entail replacing current large taxes—designed within the framework of the linear economy and beneficial to it—and introducing new types of circular tax with great collection capacity.

When introducing radical structure changes to the tax system, powerful barriers will inevitably arise. Defining and refining policies, then gaining minimum international consensus among relevant countries, is a long and arduous social and policy process. With such formidable obstacles to overcome, these ambitious proposals could suffer the same fate as their green economy predecessors have since the 1990s.

Given the urgency of the serious environmental challenges we face, waiting is not an option. It, therefore, seems reasonable to propose changes to the current tax system that are feasible and viable in the short term and that will foster the transition towards a circular economy and sustainability. The starting point is an essentially dysfunctional fiscal framework, given the principles on which large taxes are based and because many tax benefits are available to key sectors of the linear economy that have a high environmental impact. In moving towards a circular economy, the first steps should focus on ambitious reform and make use of available tax expenditure measures, including the many tax benefits, exemptions, deductions, and allowances applicable to existing large taxes (e.g., VAT, income tax, corporate tax, etc.). Due to the current huge presence of tax expenditure in the general tax policy (mainly with nonenvironmental purposes) they could be reshaped and used to promote the transition towards a circular economy, in line with the proposals discussed above. First of all, we must do away with all environmentally harmful subsidies and tax benefits and replace them with a tax treatment favourable to all circular and sustainable activities.

Such a transition would be reinforced by measures to facilitate the shift from the current taxation of labour-related activities to taxation of resources, non-renewable energy, and GHGs. This would substantially increase the coverage of the environmental tax base and progressively increase the applied tax rates. Of course, future research is needed to develop the specific measures of the tax package and their detailed design. Furthermore, to complement these fiscal measures, it would also be necessary to keep a comprehensive policy mix, including a set of environmental plans and programs, going, such as incentives for green technological development, introduction of technical standards, regulations against polluting activities, conservation programs, etc.

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TAXATION AS A STRATEGY FOR CIRCULAR ECONOMY THROUGH SUSTAINABILITY REPORTING: THE AGENCY THEORY PERSPECTIVE

Hussein Alfatlah, Universiti Teknologi Malaysia
Rafidah Othman, Universiti Teknologi Malaysia
Rohaida Basiruddin, Universiti Teknologi Malaysia
Akeel Almagtome, University of Kufa

ABSTRACT

Greenhouse gas emissions and energy usage have grown because of increasing awareness of sustainability reporting, more concerns about climate change, and new laws and levies. Audit committees, management, internal auditors, external auditors, and other stakeholders may all have a role in sustainability reporting. This article examines the potential impact of agency cost (AC) from a tax perspective on sustainability reporting (SR) in a global context. This study uses data from 693 companies from 54 countries. This study uses its model to estimate the interaction of AC and GRI to assess SR. The results show that the lowest tax rate is in the countries of the Middle East and Africa. Egypt, Iraq, Jordan, Estonia, Tanzania, and Burkina Faso recorded the lowest disclosure rate. These results reflect that taxes describe the reporting of sustainability information. This study provides a new perspective on AC; Also, the results add to our understanding of other predictors of SR quality that demonstrate more explicit approaches to predicting its efficiency. Finally, the article presents some conclusions, as well as more research possibilities. Our findings point to the need for effective monitoring. According to agency theory, there is no single explanation that thoroughly explains our results.

Keywords: Sustainability Reporting, Agency Costs, Taxes, Political-Economic

INTRODUCTION

The circular economy (CE) is a critical approach to strategic management research. It is seen as a way to help businesses operate more sustainably. It is recognized as a means of reconciling the competing demands for economic development and environmental conservation in the face of the limits of the linear economy. Despite the assertion that CE requires additional engagement globally, it is alleged that CE seeks to fundamentally improve the current business model by applying preventive and regenerative eco-industrial development and increased well-being. The word "sustainability" has become a catchphrase in the twenty-first century. It reflects the hope for social change into a much more equal and stable society in which the natural environment and our cultural contributions are maintained for future generations (Khaghaany, 2019). This pledge touches on basic expectations and concerns that have previously influenced and challenged thousands of academics. For the last 150 years, the pursuit of global prosperity and social justice has been a significant issue (Hummel & Schlick, 2016). Worry about the holding potential of natural environments links together the current significant threats that humankind is experiencing. Given companies' environmental, social and economic impacts, companies are now subject to an increasing array of regulatory requirements covering ecological concerns, labor conditions, and human rights (Hameedi, 2021). Management will, hence, for two purposes, provide information on sustainability. First, management can provide environmental and social disclosures to protect its interests to cultivate, maintain, and validate

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relationships by projecting an appearance of support to society in general. In addition, organizations can report sustainability-related information to avoid potential Organizational interference. The government, like other shareholders, is looking for reports from companies to keep track of how resources are being used. Lemon & Cahan (1997) argue that increasing environmental information disclosure is related to the tax level. It is the core of the Agency Theory.

The agency's problem occurs because the agent may not always behave in the principal's best interests. This chance provides rise for AC. It includes monitoring costs incurred by the principal to restrict the agent's discretionary behavior, bonding expenses incurred by the agent to limit and guarantee the agent's discretionary conduct. The residual losses are arising from the agent's discretionary conduct to the principal(s). Due to' excessive' rates of executive compensation, it is one aspect of this latter element of ACs-residual losses. Stakeholders are motivated to adopt selfish policies due to various conflicts of interest between managers and stakeholders. The cost of solving conflicts of interest imposes specific expenses called ACs (Ross, 2008). Ross argues that an AC is a form of internal company cost resulting from an agent's activities working on a principal's behalf. Jensen and Meckling (1976) assert that If both parties involved in the contract are profit-driven, there is a decent possibility that the agent does not always act in the principal's best interests. According to Jensen and Meckling, the principal will mitigate interest differences by providing fair opportunities for the agent and incurring monitoring costs to reduce the agent's aberrant behavior (Al-Wattar, Almagtome, & AL-Shafeay, 2019). However, in some cases, it will request that the agent spend resources on bonding costs and guarantee that it will not take any action that will influence the principal or if the principal will be charged. In the context of ACs, the green or environmental tax has drawn rising attention in the face of increasing worries about significant ecological challenges. Several researchers have concluded that pollution taxes are an effective tool to achieve environmental goals (Baumol et al., 1988). Bovenberg and De Mooij (1994) claim that several researchers have moved much further to indicate that green taxes can bring benefits beyond a cleaner environment. Policymakers, in specific, can use pollution tax income to lower other distortionary taxes. Green taxes can thus create a double profit, not just a clean environment. This argument suggests that green taxes could be moved above that of a tool for protecting the environment and that these instruments could also be used as an income-raising tool. Some policymakers' green target is the first dividend, which is to reduce carbon emissions. Some European countries follow carbon dioxide taxes and different measures to achieve these goals: fuel levy. The use of carbon-emitting fossil energy is discouraged by such a tax. Social security contributions (SSC) are among the non-wage employment tax collected by businesses for each employee.

Prior studies have not yielded a clear picture of the relationship between SR and AC. In particular, ideas from agency theory are not concerned (A. Almagtome, Khaghaany, & Önce, 2020). According to agency theory, the government enacts rules, legislation, and taxes to regulate corporate conduct. As a consequence; therefore, we suggest that corporations' sustainability efforts and reports should be affected. Future research should concentrate on how information is reported rather than on SR quantity by categorizing disclosure items as reported or non-disclosed in previous studies. Furthermore, proxies for taxes and SR must capture similar material to measure the theoretical consequences of agency theory and Political cost theory.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Many elements have been identified in the accounting literature that helps to explain why firms provide more feedback than is required. Among empirical studies, agency theory is the most thoroughly studied theoretical framework (Ifada, 2021; Tran, 2021). For the reason that the connection between the shareholder and the manager of the company is composed of a perfect agency agreement,

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it should be unsurprising that the issues surrounding the separation of ownership and management in modern diffuse companies are inextricably linked to the overall agency conflicts (Jensen & Meckling, 1976). The agency definition, which is used to describe conceptual, financial decisions, voluntary transparency, and the mandatory appointment of auditors. The organizational impact on proposed accounting standards is used to understand pay issues in an entity due to the division of ownership and capital control (the primary agent concern) (Morris, 1987). Financial disclosure is a way of tracking management behavior; managers are therefore encouraged to disclose information voluntarily. Furthermore, according to the agency hypothesis, more competitive firms are more vulnerable to market pressure and, therefore, more likely to employ self-regulation tactics to counteract external influence. More capital resources will be available for profitable firms to deal with new reporting requirements (Ng & Koh, 1994). AS are higher for firms with a higher debt ratio in their capital structure. As a result, sharing more details would help them save money at the company. Furthermore, most debt covenants contain provisions for voluntary disclosure. As a result, organizational profitability can be an essential factor, and heavily leveraged companies are more inclined than low geared firms to comply with voluntary pronouncements (Bradbury, 1992; Almagtome, 2020). Managers have also benefited from the advanced understanding and exchange of competitive intelligence industries to increase firm value and management benefits. Executives can include sustainability disclosure to reduce agency costs, remove tight internal control, and benefit from the availability of sustainability reporting in stock markets.

Under the agency theory, the legitimacy theory is described as the most popular theory that justifies SR (Azizul & Deegan, 2008). Like the main-agent relationship, the legitimacy theory suggests a connection between the organization and society and those firms seek credibility by meeting societal standards. Considering that the community has allowed the company to use social and environmental resources, the company should carefully use them. Hahn & Kühnen (2013) bring a statement of legitimacy theory. Reporting of sustainability is expected to be a prerequisite for a company's claim to legitimacy. It provides a broader justification for companies disclosing sustainability-related data. Companies are being pressured to do business socially responsibly, and sustainability disclosure responds to that pressure. In this context, Hummel & Schlick (2016) claim that only sustainability companies prefer high-quality reporting of sustainability to show their superior market performance. Moreover, based on the theory of legitimacy, weak sustainability practitioners prefer disclosure of low-quality sustainability to mask their actual performance and secure their reputation at the same time.

In terms of political-economic theory, Ramanathan (1976) argues the idea of the social contract, which implies that an organization’s existence depends on society’s help, in general, is based on the Bourgeois political economy perspective. If the government believes the company is engaging in immoral social practices, it may withdraw its funding, causing it to fail. Management may release information about their environmental and social activities to escape this situation and retain their social standing. According to the political-economic theory, the government is an essential player in safeguarding the shareholder's interests. Governments, according to advocates, play a crucial role in meeting the identities of stakeholders trying to achieve their goals. Governments will protect human rights throughout societies where an organization's activities impact or are perceived to impact the broader community. However, intervention could negatively impact the company's objectives. Using the agency theory framework, Ng & Koh (1994) indirectly refers to the AC by mentioning the various stakeholders who pressured the company to make broader disclosures while also referring to non-mandatory disclosure practices as an SR expression. Ng & Koh investigate the impact of company size, performance, liquidity, operational complexity, sector, and auditor on voluntary accounting disclosure. Non-obligatory Reporting accounting is more likely to be followed by specific, significant, profitable, and highly focused businesses. Furthermore, firms in the manufacturing and commercial sector and those audited by large public accounting firms are more likely to comply with voluntary disclosure than their competitors. The table below summarises related literature:

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Table 1
SUMMARY OF RESEARCH GAP FOR THE RELATIONSHIP BETWEEN AC AND SR

Author and Year of Publication	Objective	Findings	What needs to be done
(Mgammal, 2015)	In Malaysia, investigate the relationship between tax preparation and tax reporting.	In Malaysia, tax preparation and tax disclosure have a favorable connection.	The relationship between AC using taxes, SR is not examined yet. Studying from the agency theory perspective need to be done.
(Hong, Li, & Minor, 2016)	Examine the connection between corporate governance and the presence of CSR-related executive pay.	Direct rewards for CSR executives are an essential way to improve a company's social efficiency.	The relationship between AC using taxes, SR is not examined yet. Studying from the agency theory perspective need to be done.
(Zhu, Bu, Jin, & Mbroh, 2020)	The author of this article explores the influence of China's carbon tax policy on green financial outcomes, accounting, and transparency in the green sector.	China's environmental tax policy influences financial actions to be more environmentally friendly.	The relationship between AC using taxes, SR is not examined yet. Studying from the agency theory perspective need to be done.
(Masoumzadeh, Alpcan, & Nekouei, 2020)	Assesses how to build tax and subsidy opportunities in Australia to encourage a sustainable and low energy sector.	The importance of enacting policies that encourage people to be more environmentally conscious.	The relationship between AC using taxes, SR is not examined yet. Studying from the agency theory perspective need to be done.
(Mohammed, 2020)	Investigate the long-term relationship between Denmark's environmental tax and economic development.	The implementation of a green tax is successful in increasing the use of renewable energy.	The relationship between AC using taxes, SR is not examined yet. Studying from the agency theory perspective need to be done.

Previous studies have not provided a good understanding of the SR-AC relationship. Concepts from agency theory, in particular, are not interested (Alfatlah, 2021). The government adopts laws, regulations, and taxes to control corporate behavior, according to agency theory. Consequently, we propose that sustainability efforts and reports of companies should be affected. Rather than focusing on how much SR is disclosed or not, future studies should categorize disclosure items and concentrate on how data is posted. Besides, tax proxies and the SR must collect similar information so that the theoretical implications resulting from the agency's theory and political cost theory are correctly measured. Based on the debate and analysis of the gaps in the literature referred to above, it is apparent that the agency's costs and the disclosure are related to a reciprocal partnership that may have a mutual effect. Therefore, the costs of the agency can have an impact on SR. However, this relationship requires further testing since the above studies have primarily focused on executive compensation as a measure of AC and social SR only. Consequently, the relationship between the AC from taxes standpoint and the comprehensive SR remains vague. According to the general ground rules of Agency theory, companies provide information on sustainability in response to the demands of the institutions of the social, political, and economic processes that framed their work. As a result, it is suggested that differences in the quality and quantity of SR released across countries may be due to differences in tax features that form the socio-political and economic structures of the nations.

H1: There is a significant relationship between tax as an AC and the level of SR

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As a result, the regression equation is used to analyze the connection between AC's level from a tax standpoint and the predictor variables, SR score level. It will determine the extent to which ACs can explain SR. This analysis is in line with the study's hypotheses. As a result, the regression equation is:

$$\mathrm{SR} = \alpha_0 + \beta_1 \mathrm{AC} + \mathrm{c} \qquad (1)$$

Where:

SR=Sustainability reporting's score;
AC=ACs score;
ϵ= Standard error of approximation.

METHODOLOGY, MEASUREMENT AND SAMPLING

Agency Costs Measurement

According to the agency theory assumptions, many of the administrative, Laws, regulations, and self-regulatory frameworks intended to track the agent and stakeholders' relationships are agency relationships. Suppose they are internal or external auditors, regulatory agents, public relations offices, government regulators, insurance firms, financial consultants, or credit rating agencies. In that case, the monitors are working on behalf of stakeholders (Shapiro, 2005). Shapiro argues that all these agency relationships are facing ACs. AC comes from many sources. However, stakeholders try to reduce them. Because principals cannot monitor agent behavior, they rely on other deficient strategies. Based on this discussion, the government is an essential part of the agency contract that imposes obligations and costs on the company to protect its economic interests and protect the audience's social and environmental nature interests. Government issuing laws, regulations, and taxation to control companies' behavior, these arrangements can produce political costs. Positive accounting theory considers the company as a ligament of opportunistic working economic agents. The approach can help explain contractual debt obligations, administrative incentive arrangements, and political costs in the context of SR. This theory predicts that personality-interest will motivate all people. Direct social and environmental practices and associated reports should only happen if they positively affected the management (Watts & Zimmerman, 1986). Under the political cost theory, executives believe that this could encourage them to expose social information under intense government criticism and public pressure (Setyorini & Ishak, 2012).

The political-cost theory assumes that management facing the possibility of politically forced wealth transfers will use accounting techniques that minimize the transfer's probability or size (Cahan, 1992). Watts and Zimmerman (1978) claim that governments and their representatives equate high net profit with monopolization, arguing that governments and their representatives lack incentives or cannot entirely undo accounting information. Therefore, large-income companies will be particularly vulnerable in the form of legislation, regulation, and taxes to wealth-extracting political transfers. Managers in these companies will be forced to use accounting strategies that minimize taxable income. Researchers have investigated alternatives for political costs (ALAM, ABBAS, ZAHID, BATOOL, & KHAN, 2021). (Sutton, 1988) states that in the 1970s, the UK due to price controls in the United Kingdom. Over-profit firms were likely to be subject to government regulators' scrutiny. Sutton continues to use profitability as a political cost proxy. Indicating using the taxes as political costs measurement, Wong (1988) also discusses New Zealand's tax reform campaign in the early 1980s to

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promote such measures as recorded tax rates. Political leaders can influence corporate income re-distributions through corporate tax rates, laws, and subsidies, corresponding to Watts and Zimmerman. Certain environmental, social, and economic groups have opportunities to advocate for nationalizing, expropriating, breaking up, or controlling businesses or companies, which are viewed as providing political measures to encourage these acts. In its annual report, SR can be used creatively to monitor the relationship between a corporation and the community. It works that would improve its wealth (Setyorini & Ishak, 2012). Taxes will be used as an indicator of increasing or decreasing political pressure on organizations to expose their social, ecological, and economic responsibility, based on the discussion above. Consequently, taxes will represent the AC for sustainability disclosure. On this basis, the measurement model of AC will be as following:

$$\mathrm{AC} = \frac{ET + IT + ST + OT}{TA}$$

Where:

AC = Agency cost
ET = Environmental tax amount
IT = Income tax amount
ST = Social tax amount
OT = Other tax amount
TA = Total assets

Total assets are included in the denominator because the tax amounts paid will vary according to the company's size. Consequently, dividing the total taxes paid on the company's size will give an accurate and comparable indicator to the percentage of taxes paid by each company.

Sustainability Indicator

Many companies are releasing sustainability reports, also recognized as CSR reports or financial, social, and governance reports, in response to increasing demand from multiple stakeholder groups such as policymakers, customers, and investors to be more transparent about their environmental, economic, and social impacts (ESG). The SR arrangement of the GRI assists companies in defining, compiling, and disclosing this data straightforwardly and comparably. The Global Reporting Initiative (GRI) is the most well-known platform for companies worldwide to report their fiscal, financial, and social governance disclosures. GRI is a non-profit international standards organization that helps businesses, politicians, and organizations consider and communicate their effects on global warming, human rights, and corruption. There are two forms of Mandatory Reporting, according to GRI G4: General Standard Reporting requirements and Unique Standard Reports. In this study, a score (0), (0.5), and (1) is given based on a sustainability disclosure index. The index consists of 154 items measuring the sustainability disclosure level where the items are classified into five groups which are (general, governance, economic, environmental, and social disclosers). Content analysis will be dependent on reviewing the annual report to check out the existence or absence of statements related to sustainability issues mentioned in the study's index. The evaluation is measured on a scale of zero to one. Zero is given for non-described items, and half is given for partially-described items; one point is awarded for each item fully described in the annual report.

Sample

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The present research is using a mixed-method between the quota and Convenience sampling methods. On the one hand, Quota sampling is a sampling technique that guarantees the representation of a particular attribute or category of a population sample. This sampling design enables all types to be included in the studied framework. On the other hand, using the quota sample is to ensures the diversity of the model. Besides, companies in each country are divided into different business sectors and sizes to ensure the variety of the sample in terms of business sectors and companies' size. As a result, data is collected under the following criteria: Companies must be publicly traded on a stock exchange. Companies must have a functional website. Companies must have an SR in the GRI database that has been published; The SR and annual reports would all be available in English. The total number of available reports is (12716). This number has been subtracted from the (6379) companies that have submitted 2017 reports. Non-listed companies and reports written in languages other than English were also excluded. The final available reports are (3101). As a result, 693 companies were chosen as the research sample for 2017, accounting for 22 percent of all available information.

Table 2
COMPANIES INVOLVED BY COUNTRY

Region	Number	Region	Number	Region	Number
Australia	15	Indonesia	14	Italy	12
Canada	12	Malaysia	8	Spain	13
Ireland	13	Philippines	6	Argentina	14
New Zealand	17	South Korea	14	Chile	11
South Africa	9	Taiwan	12	Colombia	8
U. K	10	Thailand	11	Mexico	13
USA	22	Japan	40	Peru	12
Hong Kong	29	Belgium	10	Portugal	9
Singapore	23	Brazil	18	Uruguay	5
India	23	France	20	Germany	20
Nigeria	8	Tanzania	3	Zambia	3
Switzerland	15	Greece	15	Estonia	3
Denmark	10	Iraq	10	Latvia	4
Finland	10	Jordan	5	Russia	30
Netherlands	10	Chine	50	Ukraine	10
Norway	10	Lebanon	5	Angola	5
Sweden	10	Morocco	9	Burkina Faso	3
Egypt	5	Turkey	10	Ghana	7
Total\Firms\Countries					693\54

The total number of companies included in the study is 693, as seen in the list above, with companies from 54 different countries represented. The research sample is diverse enough to include participants from all over the world. By having a broader spectrum of developed countries than prior research, the current analysis contributes to our understanding of sustainability. In addition, it helps to identify the behavior of sustainability disclosure all over the world. Furthermore, the above table shows that secondary data from China, Japan, Russia, Hong Kong, Singapore, India, and the United States of America account for 30% of the research sample, ranked sequentially based on the number of companies. On the other hand, African countries are underrepresented in the study sample due to the lack of online availability of sustainability reports and the difficulty accessing them in English.

FINDINGS AND DISCUSSION

The table below shows the AC results calculated according to the research model. In general, the AC results indicate that Burkina Faso (0.001) has the lowest percentage of tax. Angola (0.079 percent), Morocco (0.621 percent), Jordan (0.624 percent), Turkey (0.801 percent), Egypt (0.822

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percent), Estonia (0.880 percent), Iraq (0.897 percent), and Ireland (0.976 percent) all have less than one percent. Therefore, these nations use the minimum necessary taxation policies that could increase the performance of SR disclosure since they do not use social security. It is worth noting that the lowest corporation tax is found in a region of Middle Eastern and African countries.

Table 3
AGENCY COSTS (AC) BY COUNTRY

Country	AC	Country	AC	Country	AC
Australia	2.56%	Indonesia	1.99%	Italy	1.21%
Canada	2.54%	Malaysia	2.53%	Spain	2.89%
Ireland	0.98%	Philippines	2.42%	Argentina	1.91%
New Zealand	1.78%	South Korea	1.86%	Chile	1.74%
South Africa	2.91%	Taiwan	1.34%	Colombia	1.53%
U. K	1.77%	Thailand	1.53%	Mexico	2.39%
USA	2.64%	Japan	1.69%	Peru	1.20%
Hong Kong	1.32%	Belgium	2.05%	Portugal	1.35%
Singapore	1.12%	Brazil	1.57%	Uruguay	1.92%
India	3.06%	France	1.16%	Germany	2.84%
Nigeria	2.30%	Tanzania	2.62%	Zambia	2.58%
Switzerland	1.25%	Greece	1.74%	Estonia	0.88%
Denmark	3.84%	Iraq	0.90%	Latvia	1.09%
Finland	1.73%	Jordan	0.62%	Russia	2.49%
Netherlands	1.41%	Chine	1.33%	Ukraine	1.91%
Norway	1.34%	Lebanon	1.13%	Angola	0.08%
Sweden	2.54%	Morocco	0.62%	Burkina Faso	0.00%
Egypt	0.82%	Turkey	0.80%	Ghana	1.01%

On the other hand, Malaysia (2.531%), Sweden (2.539%), Canada (2.545%), Australia (2.562%), USA (2.641%), Germany (2.841%), Spain 2.895%, South Africa (2.906%), India (3.059%), Denmark (3.838%), in ascending order, achieved the highest rate of tax collection. In general, 17% of the research sample countries achieved a ratio of ACs less than 1%. The highest ACs are in only two countries (India, Denmark), representing 4% of the total research sample. Also, 52% of the research sample countries achieved ACs ranging from 1% to 1.9%. Consequently, most of the results indicate that the ratio of ACs ranges between 1% and 2.3%. The SR results in Table 2 show, on the other hand, that sustainability disclosure accounts for between 22% and 90% of the total information that should be available. Among the sample countries, Egypt, Iraq, Jordan, Estonia, Tanzania, and Burkina Faso had the lowest disclosure rate. The majority of African countries reach less than a 57 percent transparency threshold. Additionally, the Middle Eastern countries' findings represent a deficiency in transparency regarding sustainability. Finland, Colombia, Turkey, the USA, South Korea, Germany, China, and Uruguay, on the other hand, have the highest sustainability disclosure rates, ranging from 73% to 90%.

Table 4
SR SCORE BY COUNTRY

Country	GRI Score	Country	GRI Score	Country	GRI Score
Australia	112	Indonesia	74	Italy	101
Canada	110	Malaysia	96	Spain	99
Ireland	101	Philippines	105	Argentina	86
New Zealand	98	South Korea	124	Chile	95
South Africa	96	Taiwan	93	Colombia	117
U. K	106	Thailand	83	Mexico	112
USA	122	Japan	91	Peru	104
Hong Kong	82	Belgium	93	Portugal	100
Singapore	73	Brazil	72	Uruguay	139

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India	96	France	81	Germany	126
Nigeria	83	Tanzania	55	Zambia	74
Switzerland	90	Greece	106	Estonia	49
Denmark	104	Iraq	39	Latvia	63
Finland	113	Jordan	47	Russia	113
Netherlands	110	Chine	130	Ukraine	90
Norway	108	Lebanon	66	Angola	65
Sweden	109	Morocco	95	Burkina Faso	57
Egypt	34	Turkey	117	Ghana	86

It is noteworthy that the majority of African nations fall short of the 57 percent criteria for transparency. Additionally, the Middle Eastern countries' findings represent a deficiency in transparency regarding sustainability. On the other hand, European countries achieve the highest reporting rate, ranging from 64% to 82%. In terms of Asian countries, the percentage of SR is compared to the G4 average. The table below presents the statistical findings of the SPSS, which investigates the relationship between taxes and the level of SR practices. The correlation findings indicate that the relationship between variables is positive and statistically significant (0. 702) at the level of 0.01. This observation adds credence to the preceding debate. Furthermore, the Kendall test result for tax and SR is statistically significant, with a correlation (0.547). The Spearman test reveals the same indicators, indicating a statistically significant correlation between agency costs and SR. The results in the table below are based on the following information:

Table 5
KENDALL AND SPEARMAN CORRELATIONS

			AC	**SR**
Pearson Correlations	AC	Pearson Correlation	1	.702**
		Sig. (2-tailed)		.000
		N	660	660
	SR	Pearson Correlation	.702**	1
		Sig. (2-tailed)	.000	
		N	660	660
Kendall's tau_b	AC	Correlation Coefficient	1.000	.547**
		Sig. (2-tailed)	.	.000
		N	660	660
	SR	Correlation Coefficient	.547**	1.000
		Sig. (2-tailed)	.000	.
		N	660	660
Spearman's rho	AC	Correlation Coefficient	1.000	.694**
		Sig. (2-tailed)	.	.000
		N	660	660
	SR	Correlation Coefficient	.694**	1.000
		Sig. (2-tailed)	.000	.
		N	660	660

Note: ** Correlation is significant at the 0.01 level (2-tailed)

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The following table illustrates testing the central hypothesis of this article. The linear regression model result shows that the p-value is less than 0.05. It shows the significance of the research's regression model and brings us to embrace the hypothesis.

Table 6
LINEAR REGRESSION

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	52909.995	1	52909.995	51.840	.000b
	Residual	669534.255	656	1020.631		
	Total	722444.250	657			

a. Dependent Variable: SR
b. Predictors: (Constant), AC

The tax index and disclosure relationship are positive - upward in terms of the relationship between the two research variables. A countries-level analysis is, in general, the indicator suggests that corporate taxes have a favorable impact on SR activities. These findings support agency theory and political cost theory discussions, which explain the possibility of taxation for purposes other than economic gain.

CONCLUSION

Local governments have recognized sustainability as a critical issue in ensuring the continued provision of public services to future generations in recent years. While most of the world's countries have launched programs to promote their sustainable development, their local governments differ significantly in management practices and produce different results due to the changes. The current study evaluates the impact of different types of institutions, the current state of the economy, and current government policies on sustainability in other countries to identify and explain the similarities and differences in the impact of tax policy on the effectiveness of sustainable development strategies globally. This article conducted an experimental investigation of 693 company reports from 54 countries in the relationship between AC and SR. Regression analysis results for a study of 693 observations confirm our hypothesis that Agency Theory explains the reporting concentrations of sustainability information. Furthermore, we prove that advanced tax regulations enable high-volume SR to signal long-term success to the marketplace. On the other hand, weak tax systems hide their motivational value toward a sustainable future while companies in such an environment attempting to preserve their credibility by offering low-quantity sustainability information. The outcomes of several model variations and additional studies confirm the accuracy of our findings. According to the existing evidence, half of the selected countries have enacted taxation or charges on natural resource production, carbon emission, toxic goods, and facilities, as well as a social tax. In Africa and the Middle East, the majority of tax systems effort also focuses on economic contribution. This evident through its corporate tax volume.

On the other hand, although some countries have achieved high rates of SR, the researchers concluded that, overall, sustainability transparency is still at an intermediate level. Our research makes significant contributions to the corpus of knowledge in many aspects. To our understanding, this is the first work to look at the effectiveness of both Agency theory and political cost theory to explain the interaction between taxes and sustainability transparency. First, we introduce a research environment where we can contextualize our assumptions by shifting the scope of inquiry from SR's quantity to what motivates SR practices. Second, we have reliable analytical data that confirms our arguments

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using a dataset of 693 organizations from 54 countries worldwide. Furthermore, our findings add to our understanding of other predictors of sustainability disclosure quality, lacking in Africa and the Middle East. Third, we refine and make more clear approaches to forecasting sustainability efficiency, considering economic, environmental, governance, and social factors. Future research in this area can benefit from the implementation of these research arrangements. Fourth, our results show the need for precise and binding reporting criteria for essential quantitative sustainability information in Africa and the Middle East from a realistic standpoint. The relationship between SR and AC has not been established in previous research. Ideas from agency theory, in particular, are not taken into account. According to agency theory, the government controls corporate activity by enacting laws, regulations, and taxes. As a result, we believe that businesses' sustainability efforts and reports should be influenced. Rather than concentrating on SR quantity in past studies by categorizing disclosure items as published or non-disclosed, research should focus on how information is reported.

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Focus 3:

World Bank, PWC, KPMG and EY on Circular Economy and Taxation

2023 Fiscal Review Committee:

PRESS RELEASEDECEMBER 6, 2022

World Bank Releases Its First Report on the Circular Economy in the EU, Says Decoupling Growth from Resource Use in Europe Achievable Within Decade

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BRUSSELS, December 6, 2022—Globally, extraction of raw materials stands at over 100 billion tons, annually. This staggering figure is driven by both the persistently high levels of material consumption in high-income countries and the rapidly growing needs in emerging economies.

The World Bank's first comprehensive report on the circular economy in the European Union (EU)—"**Squaring the Circle: Policies from Europe's Circular Economy Transition**"—states that the current "take-make-use-waste" linear model of economic expansion is increasingly unsustainable, not only on environmental terms, but also from an economic security and inclusion dimension. The report concludes, however, that comprehensive policy packages can reduce material consumption while still maintaining growth and welfare creation.

Countries in the EU are global leaders in promoting the Circular Economy transition, after making it a centerpiece of its growth strategy and embarking on a vast regulatory reform program. The World Bank report examines the EU's experience in furthering the circular economy agenda to elicit lessons that can benefit countries within and beyond Europe's borders. The report also concludes that ambitious circular economy policies could reduce Europe's aggregate material use by up to 11 percent and effectively decouple growth from the use of raw material resources within a decade.

Over the past two decades, total material use in the EU has decreased by 9.4 percent and the share of resources derived from recycled waste increased by almost 50 percent. However, while impressive, progress in transitioning to a circular economy appears more limited when viewed in relation to Europe's actual material footprint.

"Our dominant 'take-make-use-waste' global economic model is unsustainable. Current global demand for natural resources exceeds our planet's regenerative capacity by a factor of 1.75; we simply do not have another planet." said **Gallina A. Vincelette. World Bank Country Director for the EU.** "Europe is at the leading edge of the circular economy transition, but circular business models need to move from the niche to the mainstream. The good news is that the right policies, aimed at creating incentives on the pricing of natural resources, providing information for better decision making by economic actors, enabling institutions to mainstream circularity as a whole-of-government agenda, and unlocking investment - can enable significant progress."

Europe's private sector is the engine of the circular economy, however innovative circular economy business models remain limited in scale, depth, and speed of adoption. Average market penetration of these models stands at just five to 10 percent; recycled materials currently represent only 8.6 percent of raw material input, and the share of remanufacturing products compared to new manufacturing is just 1.9 percent. Without rapid scale-up, the sustainability potential of a circular economy will not be realized.

"While also paying the environmental costs of our current linear model, developing countries – particularly those whose economies are heavily concentrated on raw materials exports - also face trade related risks from circular economy policies enacted in high income countries," said **Sameh Wahba, Regional Sustainable Development Director for Europe and Central Asia**. "Developing countries need to be central to the global transition towards a more circular economy."

Finally, the report highlights that in Europe, the economic costs to be incurred from the decoupling between economic growth and material use could be offset by appropriate fiscal policies aimed at shifting the tax burden from labor to raw material extraction, use and waste.

Website: https://www.worldbank.org/eca

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Circular Economy Services

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To face the challenges of the growing world population, water scarcity, climate change and scarcity of resources, we need to change the way we consume from linear towards circular. In our view this means preserving existing value, protecting the environment and make optimal use of resources, materials and products. This brings economic, as well as societal and environmental value.

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KPMG and the Circular Economy

Creating new and innovative business models and circular collaboration

The transition towards a circular economy requires system-wide innovation to decouple (economic) growth from resource consumption. The circular economy is not only a set of principles – it defines actual actions to respond to rising trends and needs. We support businesses to operate in an era of this systemic change.

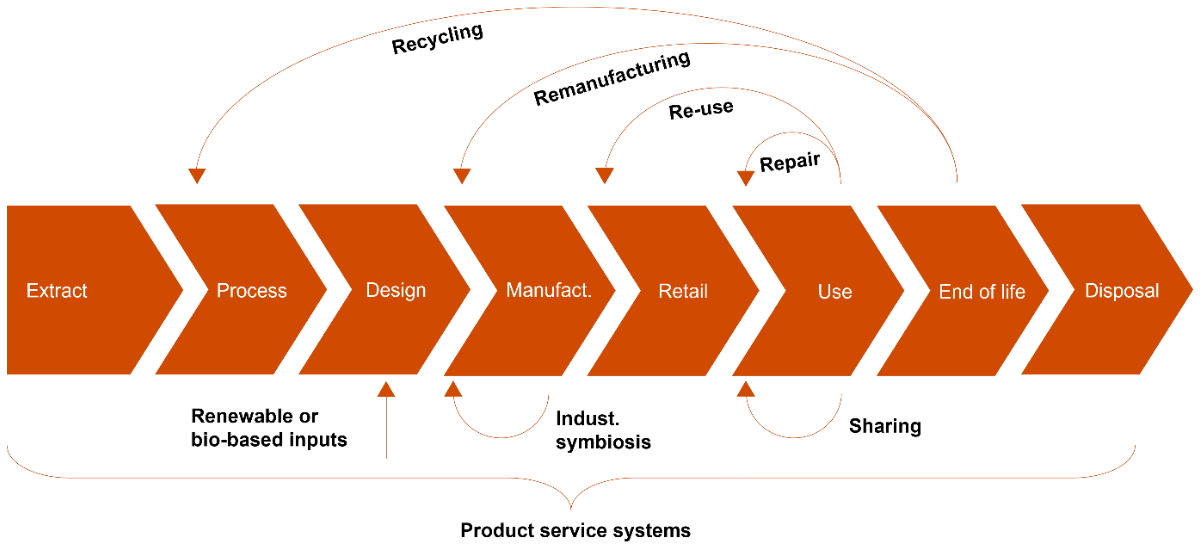
KPMG supports with circular value creation

The concept of co-creation to develop futureproof strategies and business cases is one of the key elements to always keep in mind. This is where KPMG Sustainability brings added value. We help organizations in their circular journey with our extensive experience and to-the-point services. Our services range from the development of a circular strategy to developing circular business models, and from measuring and steering circularity to activating your supply chain via our product circularity improvement program. To connect the circular ecosystem, we participate in multiple initiatives and networks, such as our knowledge partnership with Rabobank**,** our involvement in the WBCSD CTI framework and our collaboration with Circular IQ to fasten the transition to a circular economy.
We deliver three types of services:

- Circular Strategy & Implementation
- Measuring and steering on circularity via the CTI Framework or Product Circularity Improvement Program
- Circular Business Models

What is circular economy?

The circular economy is an economic system in which products are intended to stay in the economy as long as possible thanks to their design that allows products to be repaired, reused, and the constituent materials to be easily separated for recycling. Customers do not have to own products, but can borrow or share them. In this system, waste is minimized. The circular economy is in contrast to the linear model, in which waste is generated, which must be disposed of. The reasons that lead companies to focus on the circular economy include increasing prices of primary raw materials, their availability, and increasing legislative pressure. The application of circular economy principles at businesses will have a significant positive impact on global warming, as extraction and processing of raw materials accounts for about half of total global GHG emissions. Therefore, customers and business partners are increasingly preferring companies with a business model supporting circularity, and thus sustainability.



Source: OECD (2019) Business Models for the Circular Economy. Opportunities and Challenges for Policy. OECD Publishing, Paris.

The circular economy is beneficial for businesses, e.g.:

- reduced risk of disruption and price volatility of supplied raw materials;
- higher productivity and competitiveness;
- innovations in the production process, which can lead to a further increase in effectiveness and cost savings; and
- new business opportunities and possibilities to enter new markets,
- by attracting new customers and establishing long-term business relationships with them.

PwC is one of the founding members of Circular Slovakia – a sharing platform in circular economy

Our goal, together with our other partners in Circular Slovakia, is not only to ensure the sustainability of our economic environment, but also to find effective business combinations.

Circular Slovakia's goals include:

- increase general awareness in the area of circular economy;
- promote active discussions between the public and private sectors on opportunities and eliminate barriers to the transition to a circular economy;
- develop new projects and create partnerships between public administration, research and business; and
- exchange experience and knowledge, and present successful implemented examples.

Circular
Slovakia

The founding partners of Circular Slovakia are:

How tax is influencing the design of sustainable supply chains

Statutory tax penalties and incentives around sustainability and the environment are forcing a radical rethink of global supply chains.

In brief

- Tax considerations are becoming more central to efforts by organizations to make global supply chains more resilient and sustainable.
- The tax function will play a central role in helping organizations take advantage of government green incentives while reducing exposure to penalties.
- Businesses that do not prioritize these tax, sustainability and supply chain issues risk incurring penalties and costs, and missing opportunities.

How EY can help

While some supply chain disruption is visible and predictable, many global businesses are now learning the inescapable truth that most isn't. The security of global operations is being threatened by a range of unforeseen forces — from extreme weather events and pandemics, to trade disputes, geopolitical U-turns, and material supply and capacity constraints, with destabilizing shortages in staples like semiconductors and fuel.

"This disruption has caused companies to really think about the supply chain of the future," says Jay Camillo, EY Global Operating Model Effectiveness Leader, International Tax and Transaction Services. "They need to ensure sustainability in terms of having the resilience to continue to fulfill customer obligations and service levels, maintain cost competitiveness, and balance risks - all while reducing their environmental footprint."

Indeed, consumers are increasingly demanding sustainable products. The best employees want to work for organizations that provide value to society, and investors need to see that brands are moving in step with public tastes. Yet there is another factor influencing the design of global supply chains — tax.

Many countries around the world are pursuing a two-pronged approach to sustainability. This includes introducing incentives – in the form of funding, grants, credits and rebates – as well as penalties for activities creating negative environmental externalities.
While the EU is the front runner in green incentives, others are following. In the US, IRC Section 48C has allocated US$2.3b billion in tax credits to clean energy manufacturing projects and looks set to expand the provision.1 And while most developing countries don't yet offer sustainability-specific incentives, they are likely to follow suit in due course.

"It will come," says Brian Smith, EY Global Incentives, Innovation and Location Services Leader. "Southeast Asia is looking to adopt more green incentives, focusing on R&D technology, to make assets more green-friendly. China is adopting more green policies, to encourage production in certain industries. As we head towards things like the electric vehicle economy, everyone's going to have to follow."

Governments are upping their game

When it comes to penalties, many governments are introducing carbon taxes and other pricing instruments to reduce carbon emissions and other negative environmental outcomes such as waste in the supply chain, and to instead drive investment towards more sustainable manufacturing and logistics.

One of such pricing instruments is the EU's Carbon Border Adjustment Mechanism (CBAM) which is set to come into force in 2026, albeit the reporting requirements will commence in 2023 for specific group of products. Unlike carbon taxes and costs emission trading system related costs, which apply to stationary production facilities, CBAM costs as they are currently proposed, apply at the point of importation into the EU but are also impacted by the carbon regimes in the country of the origin.

"As more environmental externalities, whether carbon related or not, are identified and written into the green legislation, supply chains will be subject to taxes and pricing measures at multiple places in the supply chains," says Alenka Turnsek, EY EMEIA Sustainability Tax Leader. "The environmental tax and regulation legislation landscape is increasingly complex and fragmented."

And it's set to get even more complex with the introduction of new style plastic packaging taxes from 2022, expansion of the extended producer responsibility schemes, and other waste-reduction related pricing tools, all of which target reduction of waste and increase of reuse and recycling of plastic packaging and other materials. Water preservation and biodiversity pricing and preservation measures are expected to rise up the international agenda too.

Chief operating officers (COOs) and chief supply chain officers will have their work cut out. In the pursuit of resilience, they may well need to embed end-to-end visibility and risk monitoring in their supply chains; design versatile and agile networks; develop solid operating models and workforces; and secure alternative sources of supply.

To that list, they can add the demands of sustainability – ensuring sustainable products and designs that enable resource preservation through circular economy, which requires moving closer to customers or exchanging materials with more positive environmental and social footprint; decarbonizing the value chain; and establishing a culture of traceability, transparency and disclosure across the supply chain.

But this, says Hein Brinkmann, Associate Partner, Supply Chain and Operations, Ernst & Young Abogados SLP, is merely the first step in a longer journey. To be able to fully comply with governments' targets, he believes companies will need to adopt circular business models, lengthening product lifecycles and taking responsibility for the product at the end of product life. This will enable them to further improve their energy consumption and material efficiency. This presents a significant business opportunity.

"How are you going to define a new business model, that does not target ever increasing production volumes?" asks Brinkmann. "This requires a redefinition of the product and services catalog and a host of different capabilities and supply chain processes, which then triggers a lot of other discussions, including around tax and incentives.

"I think there will be a tsunami of change coming towards us in the next 5 to 10 years. It's a positive thing, but there's a risk that companies won't manage the transformation well. They can either be one of the leaders in the circular economy or a laggard."

The role of the tax function

If it's clear this all puts pressure on COOs and chief supply chain officers, the tax function has a key role to play in the shift too. For one thing, the rise of sustainability means new products and services bringing new value, or new value being placed on existing processes and products because of their positive economic, environmental and societal impact on the companies and their stakeholders. And this "value-led sustainability" will have tax implications.

“It’s a direct tax issue,” says Camillo. “Who in the business is funding and driving the added value? And which entity within the corporate structure is going to own the innovations? Innovation driven by mechanisms like CBAM, will require monitoring and analysis of the development of value-adding solutions to ensure the income tax consequences are well known in advance.”

This has major implications for the common practice of transfer pricing. In the latest **EY Transfer Pricing Survey**, published in October 2021, 68% of respondents said that ESG and sustainability policies in their organization would have a medium or high impact on their approach to transfer pricing. And 74% said supply chain change would have a similar medium or high impact.

Why? Because in order to deliver this added sustainability and potentially move to a circular model – providing lower cost goods while realizing a higher margin – the business will need to make investments in its supply chain, for which its R&D function needs to be compensated. This may fundamentally shift the weighting of value across the organization.

“It may be that a function is being performed in a different country to what it was before, or it’s a completely new function that will need to be remunerated,” says Ronald van den Brekel, EY Global Transfer Pricing Market and Innovation Leader.

Van den Brekel cites the experience of a client in commodity trading that had developed software to prove the origins of its products and track them across the value chain. Software development would ordinarily be considered a cost of doing business, but as the insights from this software solution were clearly key for the business, it became a major value driver. The company then had to face questions around where the software had been developed and decide whether it should charge a royalty or license fee.

"Very often, companies deal with sustainability like it's business as usual, with a theoretical understanding that it's sparked a change in value drivers," says van den Brekel. "But often they haven't fully thought it through, and they haven't changed their profit allocation to fit."

Plotting the way forward

Transfer pricing is just one area in which, having rethought its supply chain, a company may find itself exposed. Indeed, while greater sustainability brings potential opportunities, organizations will need to address exposure to the aforementioned sustainability taxes through supply chain transformation enabled by abundant incentives.

Restructuring and environmental and societal future-proofing the supply chain should mitigate exposure to many of the taxes and regulations now being introduced. It should also manage business risk, in both reputation and supply chain security.

Businesses stand to gain a lot by striking this balance. To achieve it, the C-suite and tax leaders should consider the following key steps:

- Understand the emerging green legislation and taxes, as well as the changing incentives landscape: Are tools and measures already in place? Where are they anticipated? And what do they look like?
- Know who owns and contributes to sustainability strategy: Green taxes are called tax, but in nature they are above the line costs, aimed at changing behaviors. Responsibility for the sustainability tends to vary between companies and does not always rest with a single role/ function. The implementation of the sustainability strategy requires collaboration across functions in a way that may not have been required historically. A common goal spanning functions and geographies stretches the current organizational structures and performance indicators.

- Convert that understanding into what it means for the business in financial terms: Establish supply chain sustainability goals that apply to the entire ecosystem.
- Keep the tax function close to operations: The tax department must be connected with the chief supply chain officer, chief procurement officer and COO, from as early in the process as possible, because many sustainability measures in the supply chain may take three to five years to have any effect. It's the job of the tax function to feed the latest information around incentives, tax, and other pricing measures into high-level planning. Failure to do so will invite extra costs.

Take a holistic view. Sustainability is a major undertaking and may require the company to adopt a new approach to collaborate across functions.

Conclusion

The world is currently witnessing the first stages of a radical overhaul of global supply chains. Faced with a range of threats, businesses around the world are seeking supply chain resilience, while looking at environmental and sustainability concerns.

With governments seeking to change companies' behavior around emissions and waste, we can expect the use of more environmental taxes, levies and other costs. And, by necessity, more incentives to enable countries to soften the blow and remain attractive as a business location.

As such, the tax function has a significant role to play in supply chain change. If a company doesn't know its environmental tax footprint, or how it's set to change, it may be exposed to unnecessary costs or it could under-utilize tax incentives on its transformation journey.

To succeed, sustainability needs clear accountability. Additionally, the tax function needs to remain in close step with operations to feed its insights into broader strategic planning from the start.

“Tax really needs to integrate with the business across all areas,” says Camillo. “This includes the carrot, the stick, transfer pricing and income tax, in order to ensure that the company not only avoids tax problems, but that it harnesses the vast opportunity that the creation of sustainable supply chains can bring.”

KPMG

Plastic Tax

Reduce, Reuse, Recycle

Introduction

KPMG IMPACT is a platform to support and empower KPMG professionals to assist clients in fulfilling their purpose and helping deliver on the UN Sustainable Development Goals (SDG).

One focus of KPMG IMPACT is on the latest global climate policy developments and their possible impact on international business. To assist with the communication of these issues, we have decided to produce a newsletter (on an occasional basis) for those who are alert to the latest climate and decarbonization developments. This newsletter focuses on proposals and developments of Plastics Taxes — most notably from the EU, its member states but also from other countries and territories globally.

Background

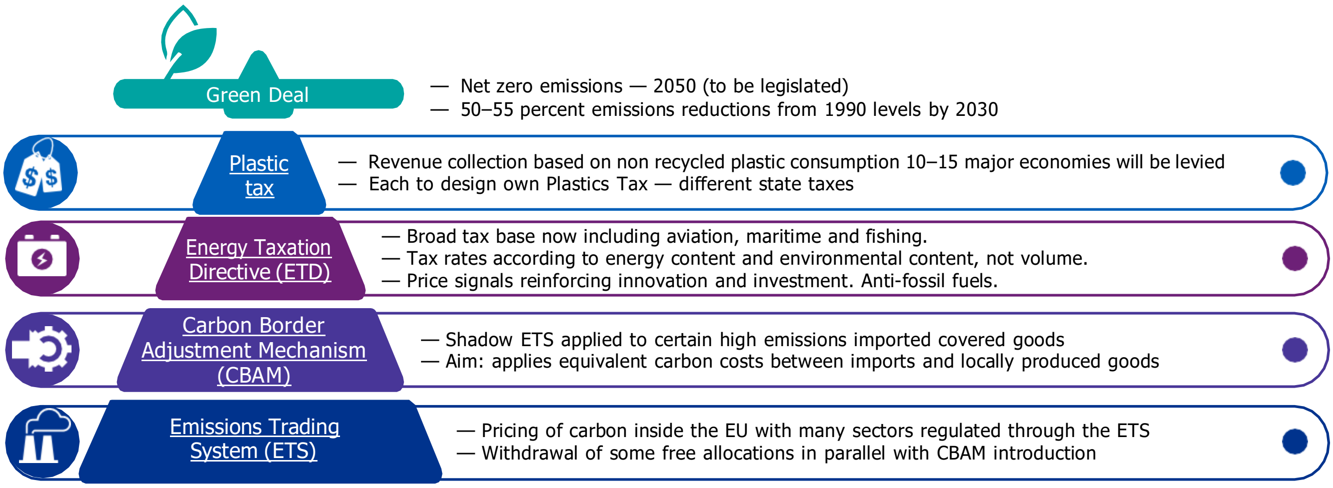
According to the UN, as of June 2021 there are 195 signatories to the Paris Agreement to limit their CO_2 emissions.[1] However, the Paris Agreement permits countries to set their own ambitions within certain parameters. Some jurisdictions or regions have undertaken to cut carbon emissions faster than others. The EU, in particular, has stated its ambition to cut emissions by 2030 by 55 percent in comparison with 1990 levels.

This commitment has been made as part of the EU Green Deal, which is a comprehensive package of tax and non-tax measures.

The EU's plastics tax is one of several tax reforms proposed as part of the Green Deal which aims to reduce consumption of raw materials and waste, promoting the move towards a circular economy.

Other significant carbon reforms were tabled by the European Commission (EC) on 14 July as part of its 'Fit for 55 package' to meet its 2030 emissions reductions goals. These are set out in Figure 1 below.

Figure 1: Tax Measures (and other interventions) in the EU Green Deal

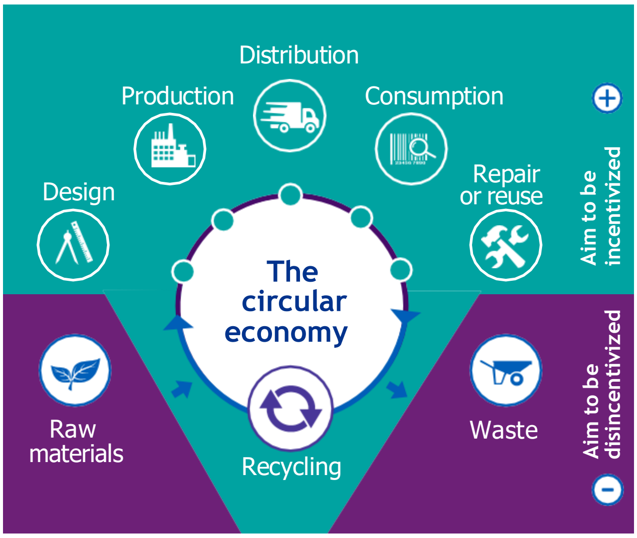


Source: KPMG 2021

[1] United Nations Treaty Collection, Paris Agreement, 12 December 2015, https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&clang=_en

The circular economy

Instead of a traditional linear model which sees natural resources introduced into a manufacturing system which are then used to produce a product which is ultimately disposed of, the circular economy, is based on the principles of designing out waste and pollution, keeping products and materials in use and regenerating natural systems[2] by minimizing the amount of new raw materials required.



Source: KPMG 2021

Taxes and tax incentives can play a part in directing behaviour at each stage of the circular economy life cycle. For example, at the production phase taxes on extraction of raw materials or on the production of high carbon products such as steel.

There are several points in the circular economy lifecycle that a plastics tax can be introduced, for example, the EU measures their plastics contribution based on the amount of plastic packaging residual waste a country generates. Whereas Spain, Italy and the UK's national plastics tax is levied when non-reusable plastic packaging is produced (or imported).

European plastic contribution

The European Union has introduced a "plastic tax" as part of the EU recovery package necessitated by EU spending as a result of Covid 19 (NextGeneration EU). This "plastic tax" is an own resource to the 2021–2027 EU budget. In fact, it is not a tax but a contribution from the Member States to the EU, based on the amount of non-recycled plastic packaging waste produced by each member state.

All Member States have already agreed to the contribution. This own resource is closely linked to the EU policy priorities.

How does it work?

Started 1 January 2021, the contribution is calculated by the weight of non-recycled plastic packaging waste with a uniform rate of EUR 0.80 per kilogram.

The contributions will be calculated based on Eurostat data, which Member States already collect and provide under existing reporting obligations (specifically the Packaging and Packaging Waste Directive and its Implementing Decision (Decision (EU) 2019/665).

Given that the exact data is reported to Eurostat in July of the year N+2, the European Commission will first calculate the contributions based on forecasts. This is a standard practice also applied for other sources of revenue to the EU budget. Once final data is available, the European Commission will adapt the calculations of Member States contributions accordingly.

For instance, in 2021 (after the entry into force of the Own Resources Decision), Member States will pay their contributions, on a monthly basis based on forecasts. This contribution will be adjusted after July 2023 when the final data will be available.

Financials

Initial estimates indicate that this new plastic contribution can provide the EU with between EUR 6 to 8 billion of additional revenue each year[3]. Set in accordance with the European strategy, the national contributions will be proportional to the quantity of plastic packaging waste that is not recycled in each Member State. In order to avoid an excessively regressive impact on national contributions, an adjustment mechanism with an annual lump sum reduction should be applied to contributions of Member States.

Below the estimated payment under the plastics tax for a few Member States, based on the weight of non-recycled plastic packaging waste in 2018 in each Member State:

Belgium	EUR 160,000,000
France	EUR 1,300,000,000
Germany	EUR 1,300,000,000
Italy	EUR 845,000,000
Netherlands	EUR 200,000,000
Spain	EUR 500,000,000

How will Member States fund the payment?

We see, at this moment, each member state having two main options when considering how to fund the payment:

— Member States will pay the contribution from their own budget, regardless of whether they have set up a national system to collect the tax. Examples are Austria and Belgium, who intend to pay the contribution from their national budget.

— Member States designing their own tax legislation and setting up a national system to collect the plastics tax by way of a tax on specific taxpayers (each country has to determine the definition of taxed products; the mechanism to collect the tax; and the refund options, etc.).

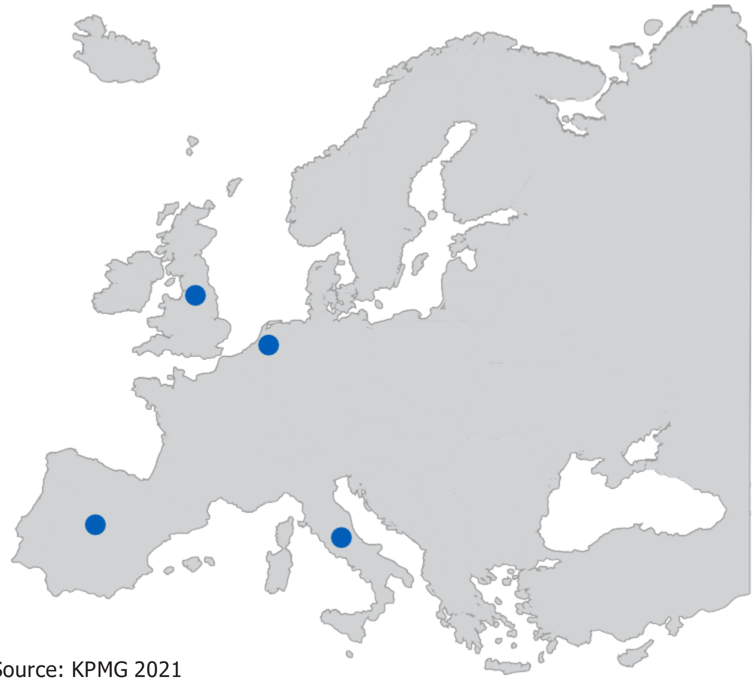
[2] https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

[3] https://op.europa.eu/en/publication-detail/-/publication/d3e77637-a963-11eb-9585-01aa75ed71a1/language-en

Country update

Many countries have some taxes on specific kinds of plastics, such as taxes on plastic bags which are present in approximately 27 countries and territories across four continents[4]. However more extensive taxes are less common.

Through discussions with colleagues in KPMG firms, we can provide the following update on which European countries are farthest along in the legislative process towards introducing more comprehensive plastic taxes.



Source: KPMG 2021

Italy

What? Italy has proposed a plastic tax on the consumption of manufactured single-use items, which have or will have the function of containing, protecting, handling or delivering goods or food products.

Who? In Italy the taxable persons obliged to pay the plastic tax are the following:

1. the manufacturer;
2. the seller;
3. the purchaser, if the items are bought from other EU countries and sold for business activity;
4. the EU supplier, if the items are bought from other EU countries and sold to a private consumer; and
5. the importer.

When? The tax liability arises at the time of production, definitive importation into the national territory or introduction into the same territory from other countries of the European Union and becomes payable when the items are released for consumption. It is expected to come into force on 1 January 2022.

How much? The rate has been set at EUR 0.45 per kilogram of plastic.

The Netherlands has published a report about the possibilities to introduce a national tax on virgin plastic. Probably taxed when plastic granules and powder are sold to producers of plastic products.

Spain

Spain has introduced a plastic tax as part of wider legislation. The objective of the new law is to contribute to the fight against climate change and to protect the environment. It includes an excise tax on non-reusable plastic packaging.

What? The excise tax is to be levied on the use of packaging, in Spain, that contains plastic and cannot be reused. Generally speaking, for the purposes of this tax, packaging is taken to mean any product designed for the containment, protection, handling, distribution and presentation of goods.

Packaging is deemed non-reusable when it is not intended, designed or marketed with a view to accomplishing multiple trips or rotations throughout its life cycle, or to be refilled or reused for the same purpose for which it was originally conceived.

Exemptions are available for packaging of certain medical products.

When? In the case of manufacture, the tax will become chargeable on the date on which the packaging is first delivered or made available to the acquirer in the tax territory. In the case of imports, the tax will become chargeable when the import duties become chargeable. We expect the Spanish excise tax on non-reusable plastic packaging will enter into force later this year/at the beginning of 2022.

How much? The tax rate is EUR 0.45 per kilogram.

The UK

What? The charge to plastic packaging tax arises when a chargeable plastic packaging component is produced in the UK or imported into the UK.

Who? The person who produces the component is liable to pay the amount charged or the person on whose behalf the component is imported is liable to pay.

When? The UK plastic tax will take effect from 1 April 2022.

How much? The rate is £200 per tonne of chargeable plastic packaging components. A plastic packaging component is chargeable if the proportion of recycled plastic in the finished component, when measured by weight, is less than 30 percent of the total amount of plastic in the component. This should encourage the use of recycled rather than new plastic.

[4] https://wedocs.unep.org/bitstream/handle/20.500.11822/27113/plastics_limits.pdf?sequence=1&isAllowed=y

What does Plastics Tax mean for business?

The attention to plastics is increasing at a European and national level and plastics tax introductions are happening quickly. It is important to remain informed about the European developments and the developments in the countries where organizations have business/production facilities as companies could face significant additional cost pass through if plastic taxes are implemented. Corporations should be compliant and in control with regard to new global plastic regulations.

Service offerings for clients

KPMG IMPACT's service offerings for businesses, in relation to plastics, include:

— **Plastics Advisory services**, like a plastic tax scan (be informed and be up to date about current and upcoming plastic regulations)

— Climate risk and **supply chain impacts** and responses and strategies to enable financial planning and effective supplier management

— IMPACT **measurement, assurance and reporting** services, enabling clients to develop and implement methods, tools and frameworks to better track and measure plastics and climate risks and opportunities.

Contacts

Loek Helderman
Global Tax Lead
KPMG IMPACT
KPMG International
E: helderman.loek@kpmg.com

Warwick Ryan
Global Leader, Virtual Center of Excellence (VCOE) for Excise and Environmental Taxes
KPMG International
E: wryan@kpmg.com.au

Barbara Bell
Director
Environmental Taxation
KPMG in the UK
E: barbara.bell@kpmg.co.uk

Christopher Morgan
Global Responsible Tax Programme Leader
KPMG International
E: christopher.morgan@kpmg.co.uk

Merijn Betjes
Global Environmental Tax Expert and Director
KPMG in the Netherlands
E: betjes.merijn@kpmg.com

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Focus 4:

Circular Economy and Taxation for more Resource Efficiency: the G20 undertaking

2023 Fiscal Review Committee:

Towards a more resource-efficient and circular economy

The role of the G20

A background report prepared for the 2021 G20 Presidency of Italy

Towards a more resource-efficient and circular economy

The role of the G20

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Executive Summary

G20 countries account for approximately 75% of global materials use and 80% of global greenhouse gas emissions. G20 governments thus play a key role in working towards increased resource efficiency and material circularity. While average resource productivity of the G20 grew by about 40% between 2000 and 2017 and more improvements in resource productivity are projected to take place in the future, these will not be sufficient to offset the global increase in materials use (OECD, 2019[1]). Moreover, when accounting for materials embedded in trade, resource efficiency improvements of most G20 countries are more modest. Unless further efforts are taken to increase resource efficiency, close material loops, and improve sustainable materials management, the growing volumes of materials use will result in significant environmental pressures, including land degradation, greenhouse gas emissions and the dispersion of toxic substances in the environment.

With benefits in environmental, economic and social domains, there is a clear rationale for G20 countries to further advance the transition to a more resource efficient and circular economy. Several G20 countries have started to develop national strategies for sustainable materials management, resource productivity or the circular economy. At the G20, resource efficiency has been on the agenda since 2017 and annual G20 Resource Efficiency Dialogues have been held since, providing a platform for exchanging views, policy experiences and good practices. Going forward, the G20 could further advance joint work on resource efficiency and the circular economy.

This Policy Guidance, prepared by the OECD at the request of the Italian G20 Presidency is intended for G20 Leaders, as well as Economic, Finance and Environment Ministries. Based on insights from across the G20 membership, this report presents possible elements of a common G20 policy vision on resource efficiency and the circular economy for different levels of government. It is expected that the vision would help to coordinate and align individual country efforts and foster international co-operation among G20 members. They key elements of a possible G20 policy vision are summarised hereafter.

National and sub-national action to advance towards a more resource efficient and circular economy

Resource efficiency and circular economy principles need to be mainstreamed in domestic policies, taking into account specific country contexts. National and sub-national action also needs to be aligned to fully leverage the role of cities in improving materials management.

Mainstream resource efficiency and circular economy principles into domestic policies

- Promote resource efficiency through a policy mix that covers the full lifecycle of products

Environmental risks are complex and need to be managed in an integrated way. This requires the application of a policy mix that considers the entire lifecycle of products, to avoid simply displacing environmental burdens to different lifecycle stages or from one environmental medium to another. A policy mix of economic instruments, regulations, information-based and voluntary approaches, environmental labelling and public financial support should internalise environmental costs and provide incentives for efficient resource use. Examples of policies that can generate environmentally effective and economically efficient outcomes include Extended Producer Responsibility (EPR), Green Public Procurement (GPP) with integrated lifecycle analysis, or partnerships with businesses and stakeholders across the value chain to support industrial symbiosis and innovation for improved eco-design.

- Align sectoral policies with resource efficiency objectives

The transition to a circular economy requires a comprehensive set of policy measures at the macroeconomic and sectoral level. Resource efficiency and circular economy should be approached as an economy-wide issue, recognising the economic benefits with regards to competitiveness, new business opportunities and innovation, as well as greater resilience against scarcity of resources and volatile prices,. Furthermore, opportunities should be sought to exploit synergies with other policy areas, including climate change. Governments can support the resource-efficient structural economic change by mainstreaming the pursuit of resource efficiency into cross-cutting policies such as in innovation, investment and education and vocational training and by aligning policies to reduce pressures from major resource-consuming sectors.

- Align COVID-19 recovery measures with resource efficiency objectives

In response to the COVID-19 pandemic, many countries committed to a "green recovery" through stimulus packages of unprecedented scale. However, only a small share of the recovery measures announced so far (approximately 1% of total funds) addresses aspects of resource efficiency and waste management. A transition to a more resource efficient and circular economy can contribute to reach long-term environmental objectives and lead to job creations and economic growth. As such, the circular economy can support economic recovery, provided that resource efficiency objectives sufficiently mainstreamed in COVID-19 recovery measures.

- Strengthen policy development and evaluation through better data and analysis

Many G20 countries have established material flow accounts and are developing indicators for resource efficiency and the circular economy. However, important gaps in existing measurement frameworks persist. Appropriate indicators should be developed to measure the environmental externalities associated with resource consumption, the contribution that resources make to economic development and the macroeconomic and employment benefits associated with resource efficiency gains. Where possible, these indicators and metrics should be harmonised across countries, regularly updated and made publicly available. Policy evaluation should also be strengthened to identify good practices and work towards better policies.

Take a phased approach from waste to resource

Specific country contexts require different policy approaches and priorities. The journey from waste to resource can be structured along four phases towards reaching a more resource efficient and circular economy. These phases can serve to identify policy priorities in a given context, depending on where a country situates itself. They are not strictly sequential and may overlap.

1. *Ensure access to affordable waste collection and treatment services*
   - Extend affordable collection services to all in society, irrespective of income level.
   - Introduce formal waste collection and disposal systems in a way that is sensitive to the economic realities of existing informal sector workers. Collaboration between local government and the informal sector is required, to ensure that existing workers are fully integrated into the new formal system.
   - Ensure the controlled treatment and disposal of waste in state-of-the-art facilities, whilst facilitating opportunities towards higher R's (i.e. reduce, reuse, recycle) where possible and avoiding lock-ins into lower-value loops or linear systems, where waste is not transformed into resources.

- Ensure sustainable financing of waste management infrastructure. Consider the use of fiscal transfers from central governments to help fund municipal waste collection and treatment.

2. *Ensure that hazardous substances in waste are managed in an environmentally sound manner*
   - Separate hazardous waste from other waste at source and manage hazardous waste streams separately in environmentally sound facilities.

3. *Start implementing a materials cycle*
   - Increasingly shift away from controlled disposal and move towards material recovery and recycling.
   - Start implementing the polluter pays principle and establish Extended Producer Responsibility schemes and landfill taxes.
   - Keep waste materials segregated, to minimise contamination and facilitate reuse, remanufacture and recycling.
   - For waste that cannot be recycled[1], develop environmentally sound energy recovery facilities and ensure state-of-the-art landfilling for residual wastes where no further materials and/or energy can be recovered.

4. *Work towards higher-value material loops and waste prevention*
   - Mainstream resource efficiency across value chains and enable industrial symbiosis.
   - Maximise repair, reuse and remanufacturing activities.
   - Encourage eco-design that allows products to be repaired, reused and recycled.
   - Enlarge recycling activities to more waste streams and maximise material recovery.

Fully leverage the role of cities in advancing towards a more resource efficient and circular economy

Cities have important competences and levers in infrastructure sectors that are key for the circular economy, such as waste management and recycling, urban transport, the built environment, water supply and sanitation. These services are often managed at the municipal level and aligning policy action on the subnational and urban level with national policies is thus important to advance the circular economy and to fulfil national targets. In shared responsibility with regional and national governments and stakeholders, cities can act as *promoters*, *facilitators* and *enablers* of the circular economy.

As promoters of the circular economy, cities can:

- Define roles and responsibilities in policymaking and implementation of the circular economy at local scale;
- Act as a role model for citizens and businesses and lead by example in several ways such as waste prevention, promotion of the use of secondary materials and sustainable products and the introduction of circular economy criteria in public works.
- Develop a circular economy strategy that builds a clear vision, defines goals, targets and priorities, allocates funds and can help to overcome the fragmentation of existing and future initiatives beyond political cycles.
- Provide information on the benefits of the circular economy to help overcome cultural barriers and improve social acceptance of the concept.

[1] As recycling and sorting technologies evolve, more waste streams can be expected to become recyclable. Countries need to be aware of potential lock-ins associated with capital-intensive waste-to-energy infrastructure.

As facilitators, cities can:

- Ensure co-ordination across different levels of government to align priorities, goals, regulation and funding sources.
- Foster system thinking to ensure policy coherence across different sectors such as waste, water, energy and transport, to maximise synergies and ensure a coherent set of incentives.
- Facilitate collaborations and dialogue between the public sector, not-for-profit actors and businesses to stimulate innovation for more sustainable production and consumption patterns.
- Seek opportunities for urban-rural linkages and partnerships at the most relevant and appropriate scale.

As enablers, cities can:

- Include resource efficiency principles in sectoral policies, such as in the built environment, spatial planning, land use and service provision.
- Mobilise and allocate financial stimulus to support innovation and the uptake of circular business models, where needed.
- Support capacity development within local administrations and across businesses.
- Support business development through spaces for innovation, partnerships and public procurements.
- Introduce an information and evaluation system based on robust data that is regularly updated and made publicly available.

International cooperation and coordination to advance towards a more resource efficient and circular economy

Supply chains have become increasingly globalised and whilst this has led to significant resource efficiency improvements, it has also led to new challenges associated with the increased complexity and lack of transparency in global value chains. The G20, accounting for 75% of global trade, has an important role in helping to ensure that global value chains achieve improved resource efficiency and that potentially adverse impacts are mitigated. Possible areas where the G20 can work together include:

- Support businesses in their value chain management efforts towards improved resource efficiency

Due to their limited jurisdictional reach, it is a challenge for national governments to influence the way global value chains are managed. This can be done more effectively at the international level. G20 countries can work together to facilitate resource efficiency improvements in global supply chains.

For instance, developing due diligence guidance for responsible business conduct, to promote the observance of environmental and social standards, can ensure that business operations contribute to sustainable development goals. An example are the OECD Guidelines for Multinational Enterprises, which currently exist for a number of industrial sectors including the garment and footwear sector, agricultural supply chains, the extractive and the mineral sector (OECD, 2021[2]).

- Alleviate barriers to trade and investment in environmental goods and services to ensure the diffusion of best available environmental technologies.

Barriers to trade in environmental goods and services, such as local content requirements and trade remedies, limit the diffusion of best available environmental technologies and reduce leapfrogging opportunities and the scope and scale of resource efficiency improvements globally. In addition, restrictions on trade in used products and waste and scrap can hamper reuse, remanufacturing and recycling activities.

Alleviating barriers to trade can, in principle, lead to resource efficiency gains. For trade in used goods and waste and scrap, it is however important to carefully monitor possible unintended consequences and environmental leakage effects.

- Harmonise environmental labels and information schemes

The last two decades have seen a multiplication of environmental labelling and information schemes (ELIS) of varying scope, size and nature. This has implications for consumers and producers alike. The growing amount of ELIS tends to increase compliance costs for producers to meet the many (regional) requirements and thus has an effect on international trade and competitiveness. For consumers, the growing label landscape leads to confusion and overall loss of credibility. Competition may also drive down the stringency of labels and standards, as different schemes bid for market share.

The G20 can work towards some degree of harmonisation in the growing field of environmental labelling and information schemes, with the aim of maintaining high standards and allowing for increased mutual recognition of schemes.

- Improve data, indicators and accounts on resource efficiency and waste

Insufficient information is available to effectively support natural resource and materials management, and resource productivity and circular economy policies. Many advances have been made in improving the information base and measurement systems, but significant data and knowledge gaps remain across countries, sectors and material types that make it difficult to get the full picture of materials use and related environmental impacts.

The G20 can strengthen work on data, indicators and accounts on resource efficiency and help develop and mainstream circular economy metrics. This can include the development of compatible material flow accounts in an international database, improve knowledge on the environmental impacts and costs of material resource use throughout the life-cycle of materials and support the development of robust and internationally comparable indicators on circular flows of materials and products, indicators that link resource stocks to material flows, and indicators that link material flows to waste flows.

- Mainstream resource efficiency and material recovery into official development assistance more systematically

A lack of financing or insufficient technical knowledge or capacity are common barriers for setting up or extending waste services in less developed countries or for implementing resource efficiency policies or initiatives. Many of the environmental and health impacts associated with illegal dumping and burning of waste, in particular hazardous waste, can be alleviated with formal waste collection and treatment services that are accessible and affordable for all. To date, a relatively small share of ODA from G20 countries that are also members of the OECD's Development Assistance Committee (DAC) is earmarked for purposes of material recovery or resource efficiency. DAC members could consider to direct a greater proportion of ODA towards the development of sound waste management infrastructure in recipient countries.

1. Introduction

Global demand for materials has been growing over the past century, following steady economic growth in OECD countries, the industrialisation of emerging economies and a growing world population. At the global level, the extraction of raw materials more than doubled between 1990 and 2017 (OECD, 2019[3]), and it is projected to double again by 2060 (OECD, 2019[1]). Due to the growing volumes of materials use, environmental impacts associated with materials management are projected to more than double in the decades to come, with adverse consequences for human health, ecosystems and the economy. With more materials being used, also more waste was generated. Recycling and recovery rates of these wastes remain low and much is landfilled, or “downcycled” and used as lower-value materials.

G20 countries contribute to an important share of past and projected materials use and have a key role to play in improving resource efficiency and to advance to a more circular economy. Comprising 60% of the world’s population, 80% of the world GDP and 75% of global trade, G20 countries are estimated to contribute to 75% of global material use (G20, 2021[4]; UNEP IRP, 2019[5]). In 2020, the domestic material consumption of G20 countries made up approximately 80 Gt.

Trends towards urbanisation and higher living standards will lead to particularly high levels of materials use in cities. By 2050, 55% of the global population is expected to live in urban areas (OECD/European Commission, 2020[6]). Already, cities represent almost two-thirds of global energy demand, produce up to 50% of solid waste and are responsible for 70% of greenhouse gas emissions (IEA, 2016[7]; World Bank, 2009[8]). Globally, at urban level, material consumption is expected to grow from 40 billion tonnes in 2010 to 90 billion tonnes in 2050, largely driven by the demand for construction material in emerging economies (UNEP, 2018[9]). As such, cities will play a key role in transitioning from a linear to a circular economy. Cities hold important competences for resource efficiency and the circular economy, such as waste management and recycling, urban transport, water supply and sanitation, land use and spatial planning. These services are often managed on municipal level and alignment of subnational and national resource efficiency initiatives is important to advance towards a more circular economy.

The recent outbreak of the COVID-19 pandemic and related economic impacts also has consequences for resource use and waste management. Whilst the growth in materials consumption halted in 2020 due to the economic downturn, announced recovery packages and related infrastructure investments will likely lead to additional resource demands in the near future. Implications on materials use will likely depend on the extent that resource efficiency principles are considered in the spending of stimulus funds. Furthermore, during the pandemic household purchasing patterns shifted and demand increased for some product groups (e.g. packaging for deliveries and online purchases or single-use personal protective equipment comprised of plastics), putting additional pressures on waste management infrastructure (Adyel, 2020[10]; Celis et al., 2021[11]). Many of these behavioural responses by households are likely to be temporary, but there is a risk that some may stick over the long term, affecting materials demand in the long term.

While over the past decades G20 countries have already achieved notable reductions in the materials intensity of their economies and this trend is expected to continue, this will not be sufficient to offset the projected global increase in materials use. Unless countries put further effort in increasing resource efficiency, closing material loops, and improving environmental management, the growing volumes of materials use will determine significant environmental pressures, including land degradation, greenhouse gas emissions and the dispersion of toxic substances in the environment. With much of the materials use and waste generation occurring in urban areas, cities and sub-national governments are important actors in this context.

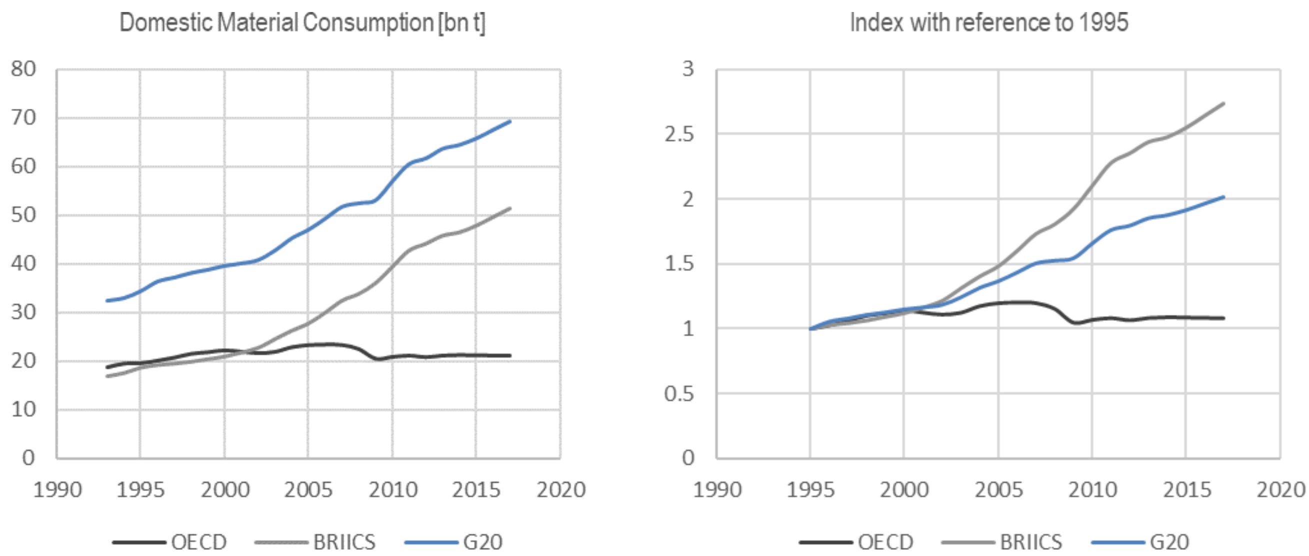
2. Past trends in material consumption and waste generation

Material consumption has drastically increased in past decades

Over the last century, global population and income growth led to a significant increase in global material consumption. Between 1990 and 2017, the world population went from 5 to 7.5 billion people and global gross domestic product (GDP) per capita increased by 50% (United Nations, 2018[12]; World Bank, 2021[13]). As a result, at the global level, annual material consumption grew from 37 billion tonnes in 1990[2] to 88 billion tonnes in 2017, while the average daily materials used per capita went from 22 kg in 1990 to 33 kg in 2017 (OECD, 2019[1]).

At the same time, the productivity of materials has improved, with a significant reduction in the material intensity of the global economy (OECD, 2020[14]). Over the past three decades, these trends have contributed to a relative decoupling between GDP and material consumption, with the global economy growing faster than materials consumption. Decoupling trends have been strongest in the OECD area, in part due to the outsourcing of resource-intensive activities to other countries (OECD, 2015[15]). Across the G20, the material intensity has also decreased, though with some variation among G20 countries. While domestic material consumption in OECD countries remained at similar levels between 1995 and 2017, it almost tripled in BRIICS countries (i.e. Brazil, Russia, India, Indonesia, China and South Africa) (Figure 1).

Figure 1. Domestic Material Consumption in G20, OECD and BRIICS



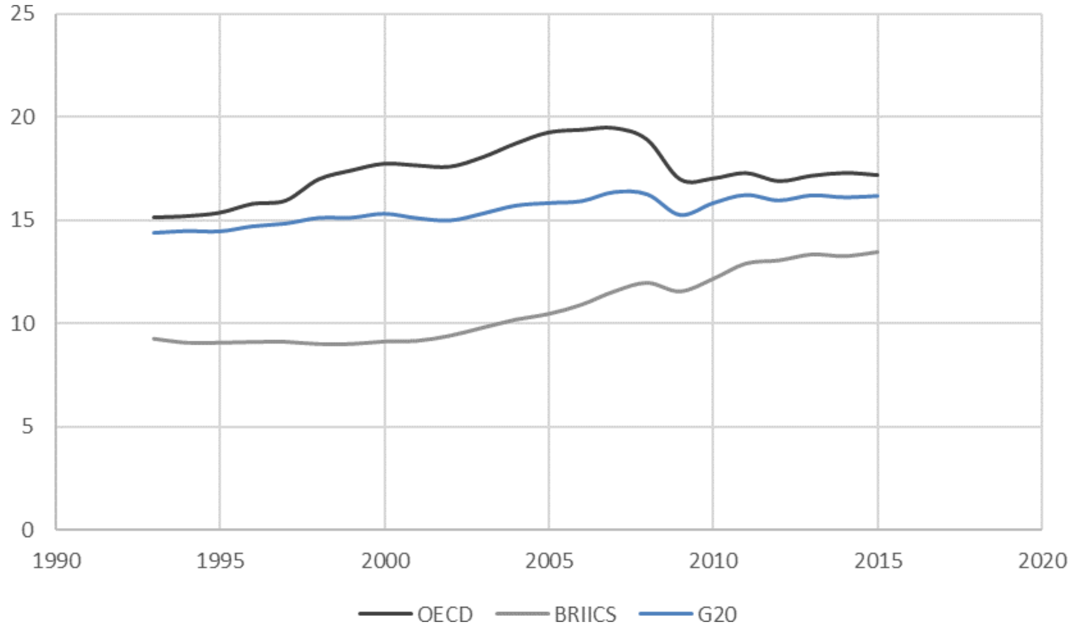
Source: UNEP Global Materials Flows Database

While absolute material consumption in BRIICS and emerging economies increased significantly over the past decades, per-capita material consumption remains lower, but is converging to OECD levels. Whereas prior to 2000, OECD citizens consumed on average 50% more materials than an average BRIICS citizen,

[2] All material consumption data referring to 1990 are likely to be underestimated, due to data availability constraints for both OECD and non-OECD countries.

per-capita DMC of OECD citizens were less than 30% larger in 2017. Per-capita consumption of the G20 increased gradually over the past decades and are close to OECD levels (Figure 2).

Figure 2. Domestic material consumption per capita [tonnes]



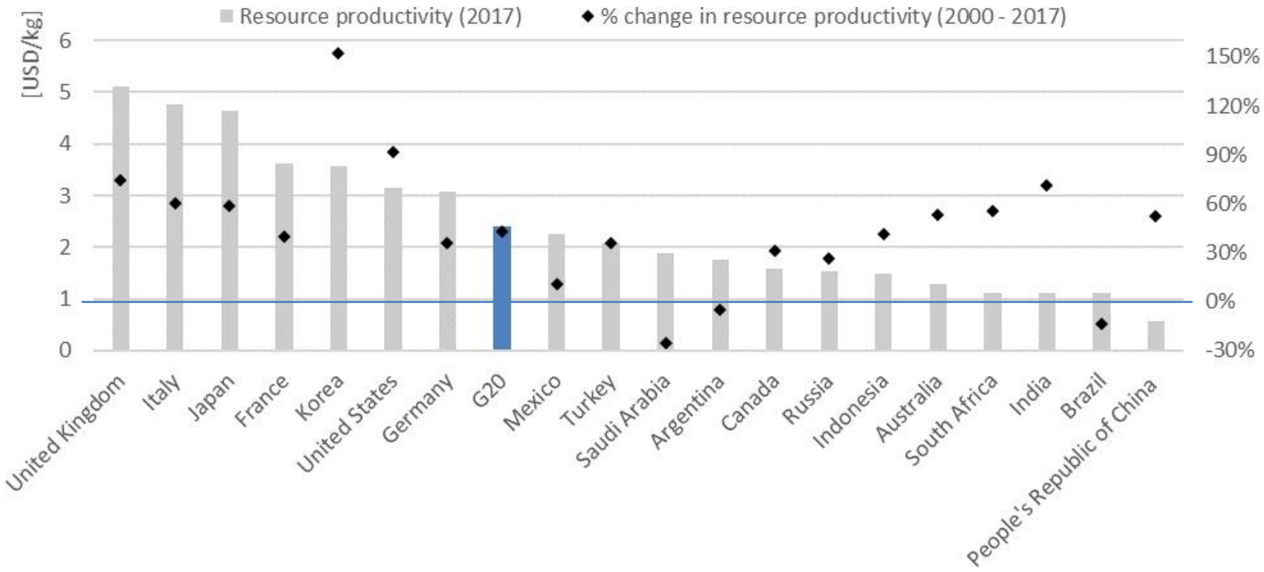
Source: UNEP Global Materials Flows Database

Resource productivity across the G20 has increased, but progress differs and much more remains to be done

The economic structure of G20 countries varies, depending on their resource endowments, development stage, demographics and economic specialisation. As such, resource productivity levels and per-capita material consumption are heterogeneous across the G20 membership. Countries with the highest resource productivity tend to be economies focused on services and high-value products, such as the United Kingdom, Italy or Japan. Countries with economies more reliant on extracting material resources tend to have lower material productivity levels, such as India, Brazil or China (Figure 3).

Among the G20, on average, resource productivity grew by about 40% between 2000 and 2017. In 2017, in G20 countries, one tonne of materials generated on average USD 2 400, while in 2000 the same amount of materials generated USD 1 700. This reflects efficiency gains in the production process, structural changes in the composition of the economy, and the partial substitution of domestic production with imported goods (i.e. the shift of material-intensive activities abroad).

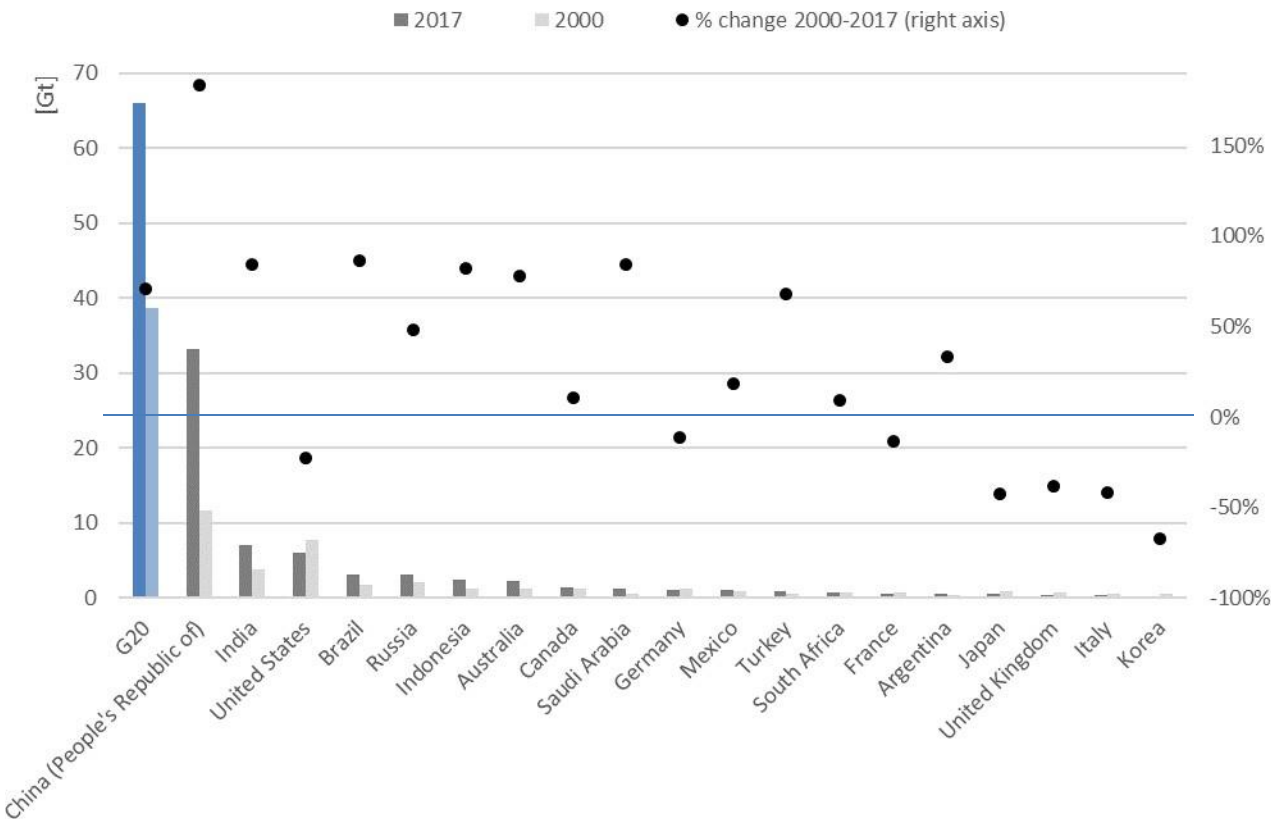
Figure 3. Resource productivity levels differ substantially among G20 countries, but some improvements could be achieved



Note: Resource productivity is gross domestic product (GDP) divided by domestic material consumption (DMC). DMC measures the total amount of materials directly used by an economy.
Source: OECD.Stat

While resource productivity levels have increased for most G20 countries, these gains are counterbalanced by population growth and increased consumption due to economic growth. As a result, material consumption continued to rise in absolute terms for most large G20 countries in the past decades. In particular, fast growing, maturing economies, most notably China, experienced an increase in materials use (Figure 4).

Figure 4. Despite improvements in resource productivity, domestic material consumption increased in G20 countries



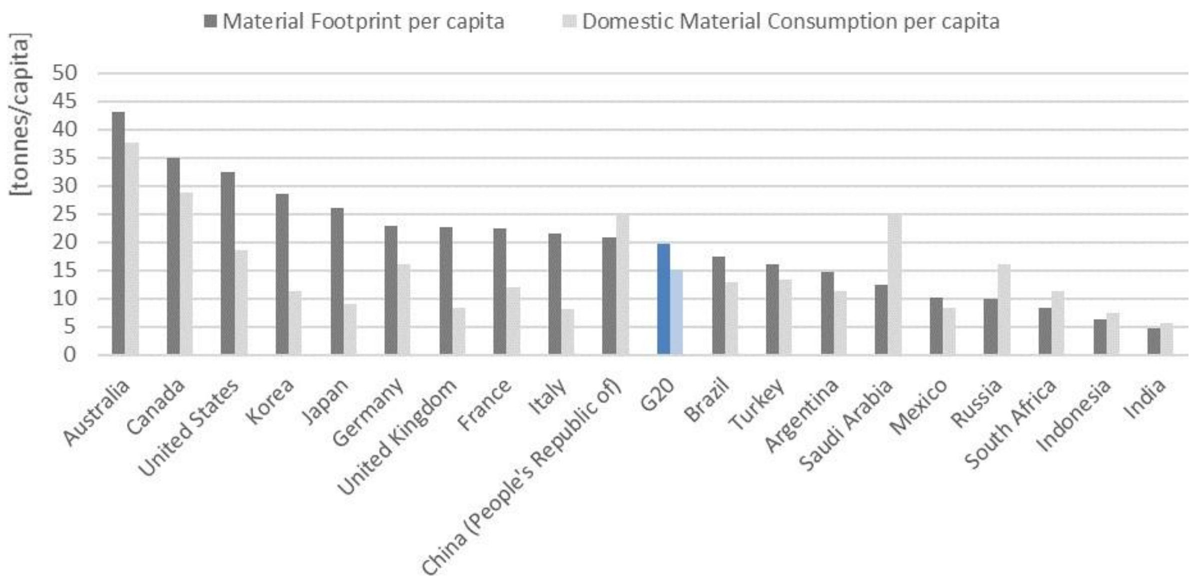
Source: OECD.Stat

Domestic material consumption is a useful indicator to quantify the amount of materials used in national economies, but it does not capture the increasing substitution of domestic production with imported goods. In many cases, G20 countries have outsourced material-intensive production. This shift is not reflected in domestic material consumption, as the metric does not account for indirect flows of raw materials embodied in internationally-traded intermediate goods and final products.

When considering the total material footprint – accounting for all raw materials needed to satisfy domestic final demand for goods – material productivity gains fall out more modest in most G20 countries. Per-capita material footprints across the G20 are on average 30% higher, than per-capita domestic material consumption. This indicates a shift of material-intensive economic activities abroad (Figure 5). Net-importers tend to be EU countries, Japan and South Korea, whereas net-exporters include Russia, Saudi Arabia, South Africa, Australia and China (UNEP IRP, 2019[5]).

Coordinated efforts are needed between importing and exporting states (i.e. between G20 countries with material trade surpluses and deficits) to improve resource efficiency along increasingly globalised value chains.

Figure 5. Material footprint per capita remains high also for countries with low Domestic Material Consumption per capita

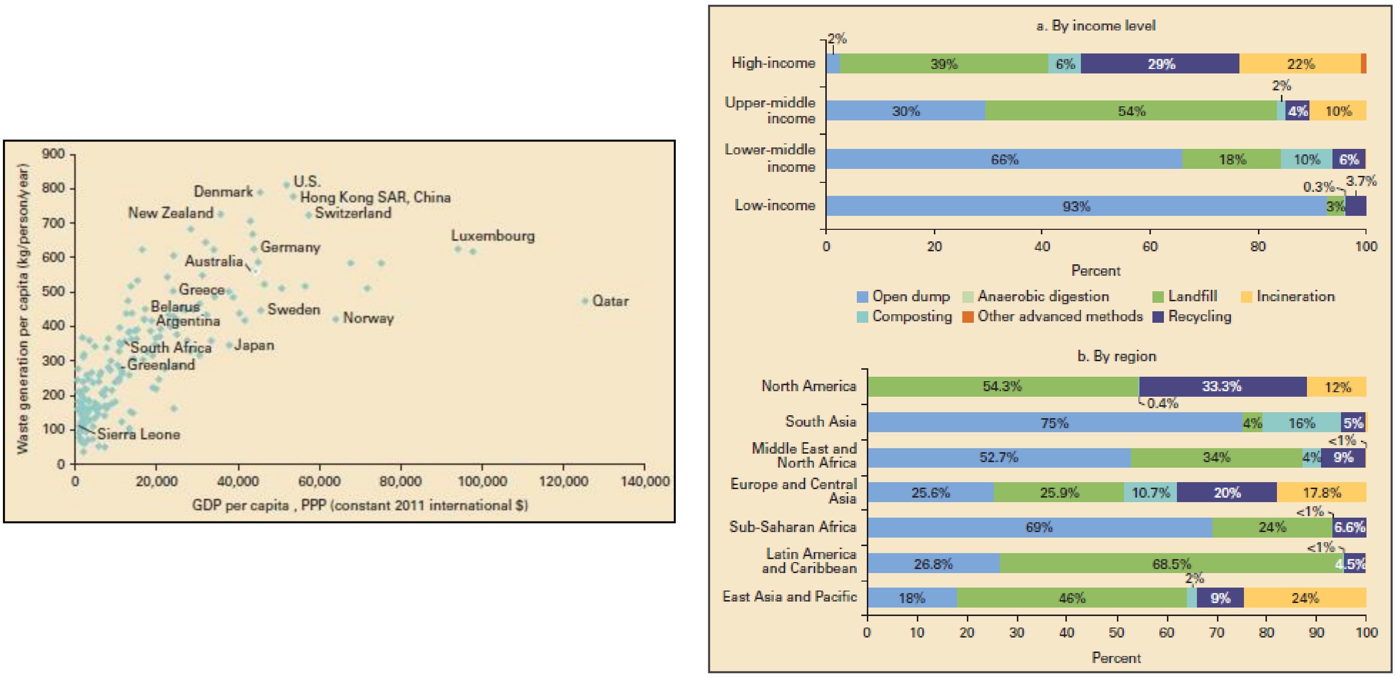


Note: Material footprint accounts for all raw materials needed to satisfy final demand of economies. It takes into account raw materials extracted abroad and embodied in imported goods (i.e. a demand-based measure). The data used for this figure from the UNEP "Environment Live" database (http://uneplive.unep.org/material). They should be interpreted with caution as they may differ from national estimates, and as they may change as international work on methodologies for material footprints progresses.
Source: OECD Environment at a Glance Platform; OECD Environment Statistics (database), http://dotstat.oecd.org/Index.aspx?DataSetCode=MATERIAL_RESOURCES

Waste generation levels and treatment processes differ substantially across the G20

Waste generation and treatment processes differ substantially across the G20, according to the different stages of economic development that countries find themselves in. As countries become more affluent, income levels rise and consumption increases, the amount of household waste generated also increases. However, at the same time waste collection and treatment processes of these wastes tend to improve as countries advance in their development (Figure 6).

Figure 6. As income levels rise, waste generation increases [left], but waste treatment processes improve [right]



Source: (Kaza et al., 2018[16])

Recycling and material recovery rates do not only differ among countries, but also among waste streams. Glass, paper and metal packaging commonly achieve the highest recycling rates as they are used in relatively simple product groups or easily recyclable. Recycling rates of more complex product groups, are significantly lower (Box 1).

Box 1. Textiles and the circular economy

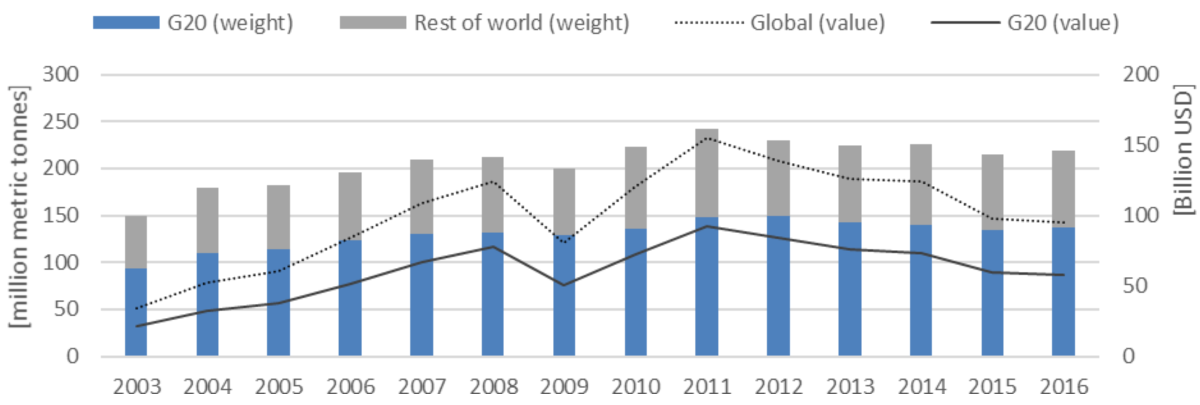
The European Environment Agency (EEA) estimates that in the EU, supply chain pressures of clothing, footwear and household textiles are the fourth highest pressure category for the use of primary raw materials and water, second highest for land use and the fifth highest for greenhouse gas emissions (European Environment Agency, 2019[17]). Globally, the apparel and footwear industries are estimated to account for 8% of the world´s greenhouse gas emissions (Quantis, 2018[18]).

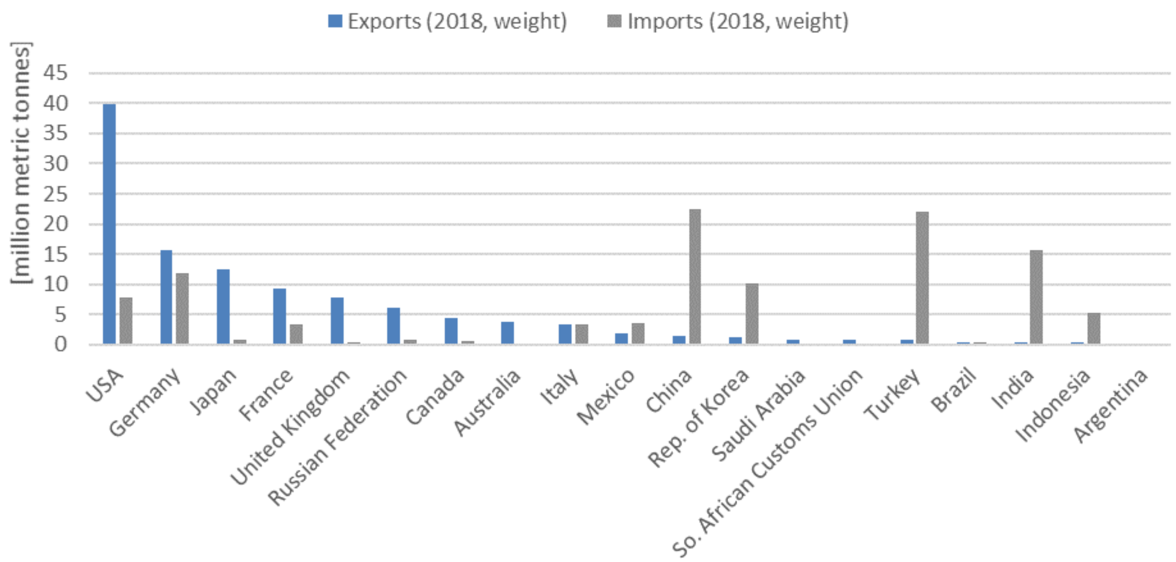
Only a small share of end-of-life textiles is currently recycled. Globally, roughly 73% of EoL textile waste is landfilled or incinerated, 14% is lost in production, use, and collection, 12% is downcycled to a less valuable use, and less than 1% is recycled to make new fibres for a textile of similar value (Ellen MacArthur Foundation, 2019[19]). Increasing re-use and textile-to-textile recycling has the potential to reduce the significant resource footprint and greenhouse gas emissions of the textiles industry (Semba et al., 2020[20]; Watson et al., 2016[21]).

Trade has influenced waste treatment and recycling value chains in the past decades. Trade in waste has led to economically efficient recycling, but also poses risks of environmental leakage, if not managed properly. Between 2003 and 2016, global waste trade between countries for further treatment or disposal increased by around 30% (by weight) and is now common practice (Yamaguchi, 2021[22]). In 2016, global trade in waste and scrap was worth USD 94 billion and amounted to a total weight of 218 million tonnes. The main traded categories of waste and scrap were metals and paper (Garsous, 2019[23]).

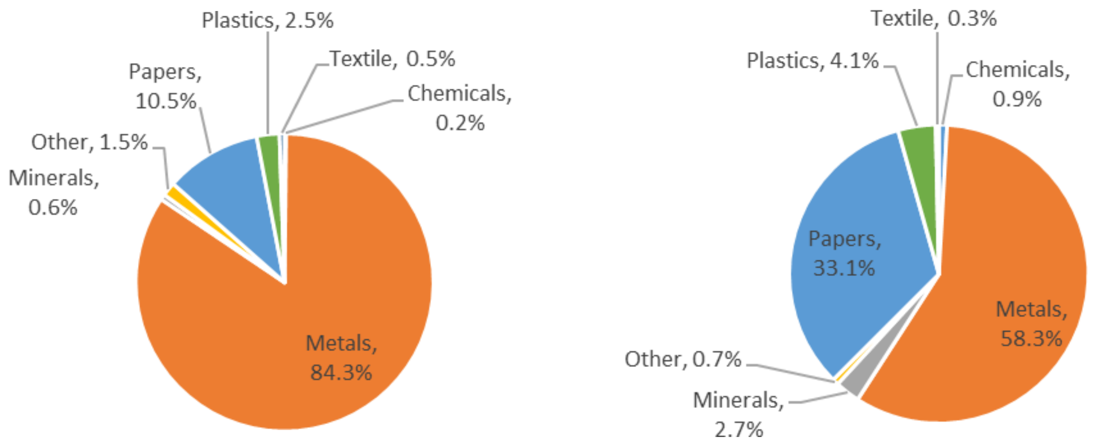
G20 countries make up for approximately 60% of the global waste and scrap trade (Figure 7). The largest exporters of waste and scrap in 2018 were the United States, Germany, Japan and France. The largest importers were China, Turkey and India. Metals scrap and waste accounted for 85% of the G20 trade by value, followed by paper (10%) and plastics (2.5%). By weight, metals represented about 60%, and paper about 30% of the traded wastes. Plastics constituted around 4% of global traded waste and scrap by weight in 2018 (Figure 7).

Figure 7. Trends waste and scrap trade in G20 countries





G20 waste and scrap trade composition by value (left) and weight (right) in 2018



Note: Waste and scrap items are those contained in the list of 62 Harmonized System (HS) codes used in (Garsous, 2019[23]) provided by (Kellenberg, 2012[24]).
Source: Author based on Garsous (2019[23]) and (UN Comtrade, n.d.[25]).

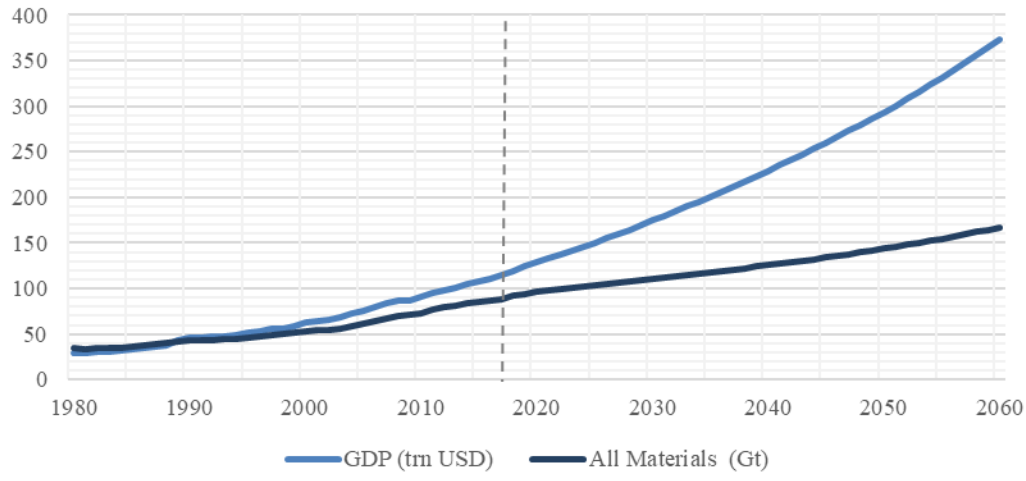
Multilateral cooperation among the G20 is needed to coordinate on trade of end-of-life products and to ensure that trade of waste and scrap enables environmentally sound and economically efficient processing, material recovery and disposal.

3. Projections of future materials use

In the absence of additional policies promoting resource productivity, materials use is projected to nearly double by 2060, compared to 2017 levels (OECD, 2019[1]). The projected growth in materials use is largely associated with the socioeconomic and technological changes that the global economy will face in the decades to come. The world's population is projected to continue growing, driving demand for energy, food and natural resources. Furthermore, global income per capita is projected to reach 2017 OECD levels by 2060. At the global level, daily materials use per capita is projected to increase from 33 kg in 2017 to 45 kg in 2060. Infrastructure and construction have the highest resource footprint of all sectors and will remain a key driver of materials use in the future.

According to OECD projections, a relative decoupling between economic growth and materials use will take place in the coming decades. Indeed, between 2017 and 2060, the world economy will continue growing at an average yearly growth rate of 2.8%, while global materials use is set to increase on average by 1.5% every year (Figure 8). This relative decoupling will happen thanks to technical advances and structural changes in the economy. At the global level, a growing number of countries is projected to progressively shift towards a more service-based economy, thus lowering material intensity and reducing global materials use by 80 billion tonnes by 2060 (as compared to a projection where structural changes would not occur). In addition, in the coming decades, technological advancements are projected to save 68 billion tonnes of materials (as compared to a projection where technological improvements would not occur) (OECD, 2019[1]). Nonetheless, in the absence of additional policy measures, structural and technological changes alone will not be sufficient to contain the growth in global materials use.

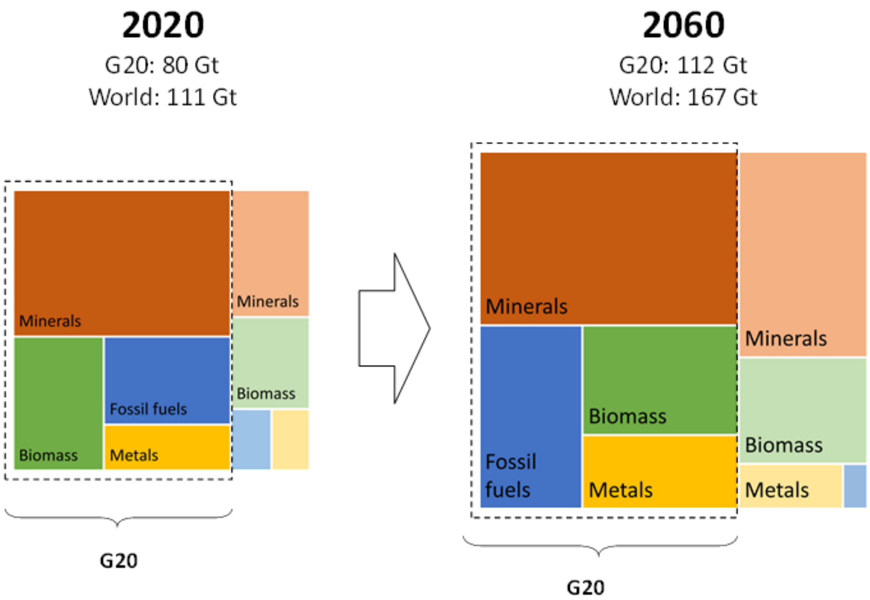
Figure 8. Partial decoupling between economic growth and materials use is projected to continue globally



Note: the dotted vertical line indicates a change from historical data to projections.
Source: (OECD, 2019[1]).

If current trends continue, domestic material consumption of the G20 is projected to increase from 80 Gt in 2020 to 112 Gt in 2060 (Figure 9). Materials use is projected to increase for all resource categories. Consistently with past trends, non-metallic minerals will remain the most used type of material in every region, followed by biomass, fossil fuels and metals. The significant growth characterising non-metallic minerals and metals use can be largely attributed to the sustained expansion of the construction sector, which by 2060 is projected to account for half of the growth in global materials use (Box 2).

Figure 9. Global materials use is projected to further increase in the coming decades



Note: The value for G20 is an approximation, based on domestic material consumption from the Global Materials Resource Outlook to 2060. The aggregate includes Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, South Africa, South Korea, the United Kingdom, and the United States. It does not include values for the Argentina, Turkey and Saudi Arabia, and the European Union, which are G20 countries and it includes New Zealand, which is not a G20 country.
Source: OECD Global Material Resources Outlook to 2060 (OECD, 2019[1])

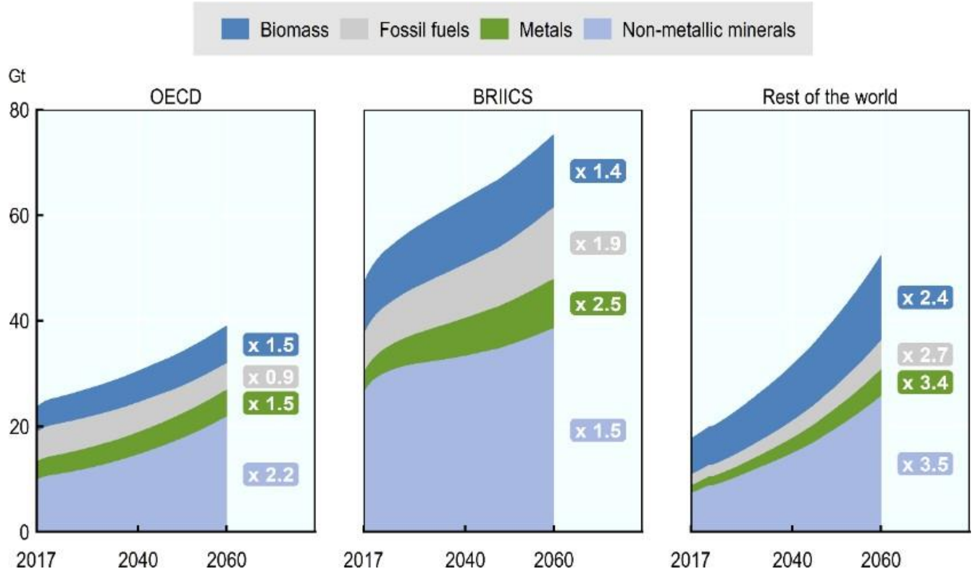
Box 2. The construction sector and the circular economy

The construction sector is responsible for a significant share of current and projected materials use. Globally, the construction industry accounts for roughly 30% of natural resource extraction and 25% of solid waste generation (Benachio, Freitas and Tavares, 2020[26]). Non-metallic minerals, which are mainly used for construction are projected to grow from 35 Gt in 2011 to 82 Gt in 2060, due to sustained construction activities in emerging economies (OECD, 2019[27]).

Increasing circularity and resource efficiency in the construction sector is important to slow global resource consumption. To date, the majority of EoL construction materials are discarded or down-cycled. This is in part due to the current design of constructed buildings. An important opportunity for circularity in the building sector is the reuse of building components and materials, which would significantly reduce the need for virgin construction materials. Further opportunities lie in the intensification of the use of building, for example through sharing economy applications (UNEP, 2020[28]).

Whereas materials use is projected to increase in every region, growth rates are projected to differ significantly across countries. On average, between 2017 and 2060, materials use is projected to grow by 65% in OECD countries and 60% in BRIICS countries. Meanwhile, materials use is projected to almost triple in the rest of the world, driven by high and constant growth rates until 2060. Despite a significant slow-down in the material intensity of BRIICS economies, the six countries together are projected to remain the region consuming the largest amount of materials in absolute terms (Figure 10).

Figure 10. Materials use projections by category and region



Source: (OECD, 2019[1]).

4. The environmental impacts of materials use

A range of environmental impacts occur along the lifecycle of materials, during the extraction, transport, processing, use and disposal of resources, products and waste. Environmental impacts range from land degradation to the release of toxic pollutants that affect human and ecosystems' health. In addition, all stages of materials lifecycle contribute to the emission of greenhouse gases (GHG) into the atmosphere, thus playing a crucial role in climate change. Table 1 provides an overview of selected environmental impacts of materials use.

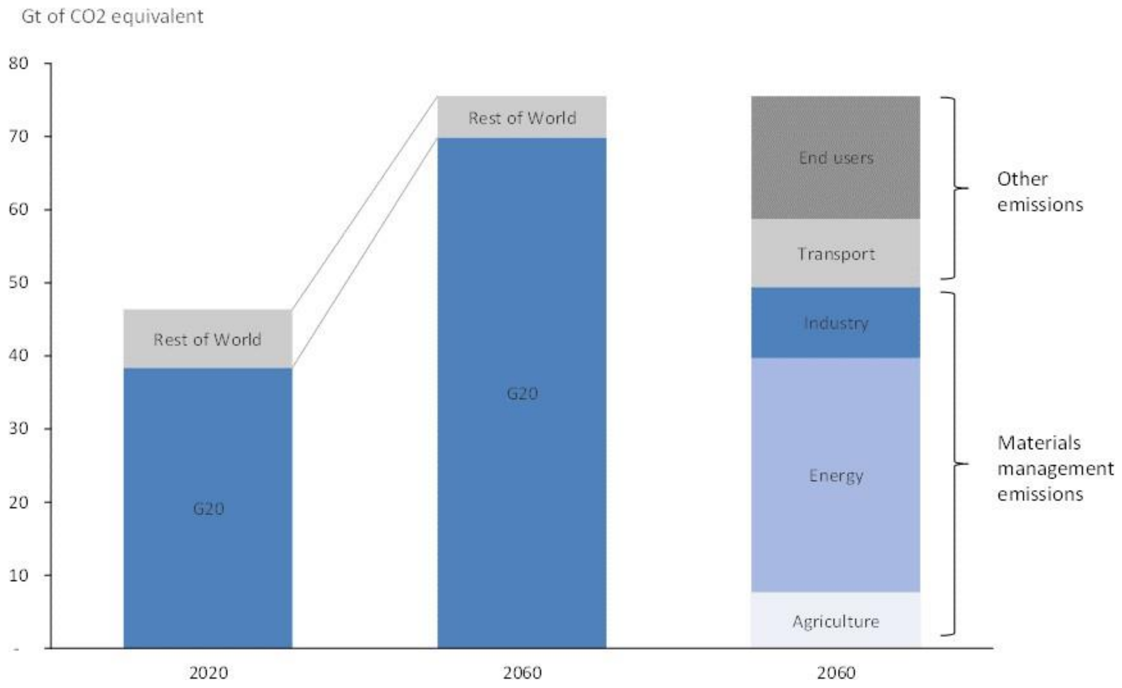
Table 1. Selected environmental impacts of materials use

Acidification	Corrosive impact of pollutants (SO_2, NO_x) on soil, water, ecosystems, buildings
Climate change	Radiative forcing of GHGs causing rising temperatures, sea level rise, extreme weather events
Cumulative energy demand	Total energy use along the production chain
Eutrophication	Impacts of nutrients (N, P) on soil and water quality affecting ecosystems and drinking water
Freshwater eco-toxicity	Impacts of toxic substances on freshwater aquatic ecosystems
Human toxicity	Impacts of toxic substances on human health, via inhalation and the food chain
Land use	Land surface used to produce the resource
Photochemical oxidation	Impacts of tropospheric ozone from air pollutants (VOX, CO)
Terrestrial eco-toxicity	Impacts of toxic substances on terrestrial ecosystems

Source: (OECD, 2019[1]).

The environmental impacts of materials use are projected to increase along with materials use and to more than double between 2011 and 2060 (OECD, 2019[1]). More than two-thirds of global greenhouse gas (GHG) emissions, i.e. 32 Gt, are linked to the materials cycle. By 2060, these emissions will amount to 50 Gt CO2 equivalent (Figure 11). Furthermore, as the nexus between materials and other natural resources – such as land, water and biodiversity – is very close, increasing pressures on one medium are likely to intensify pressures on others (OECD, 2017[29]).

Figure 11. Global greenhouse gas (GHG) emissions are projected to further increase, with more than two-thirds linked to the materials cycle



Note: The value for G20 is an approximation, as it includes Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, South Africa, South Korea, the United Kingdom, and the United States. It does not include values for the Argentina, Turkey and Saudi Arabia, and the European Union which are G20 countries and it includes New Zealand, which is not a G20 country.
Source: OECD Global Material Resources Outlook to 2060 (OECD, 2019[1])

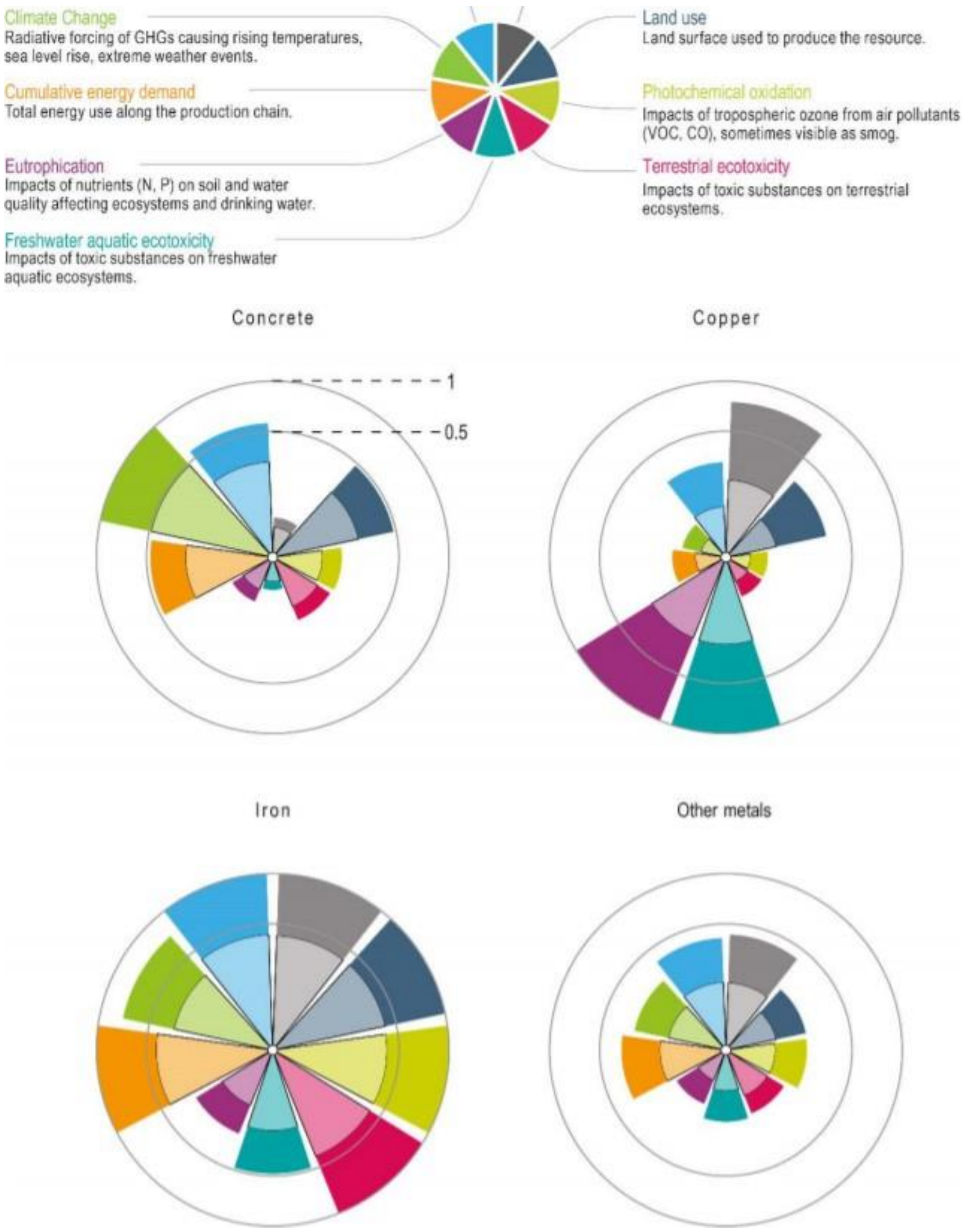
Environmental impacts vary significantly across materials. According to OECD projections, the use of iron, copper, concrete and aluminium is projected to have highest impacts on the environment (OECD, 2019[1]). Figure 12 shows the projected environmental impacts[3] linked to the use of concrete, copper, iron, and other metals – i.e. aluminium, lead, manganese, nickel and zinc.

The increase in environmental impacts is not only caused by increased volumes of materials use, but also by changes in the environmental impacts per unit of production for some refined metals, due to diminishing ore grades (Van der Voet et al., 2018[30]). The per-kilogram environmental impacts are projected to increase for instance for lead, nickel, and zinc. In the case of lead, by 2060 impacts on human toxicity are projected to increase by 76%, while those linked to freshwater eco-toxicity are projected to increase by 58% (compared to 2017). The environmental impacts of other metals, such as aluminium, iron, and manganese are projected to remain constant or decrease over time, due to the decarbonisation of energy used for production and increased use of secondary materials, which tend to have lower overall environmental impacts compared to primary materials.

[3] The environmental impacts displayed are calculated using a cradle-to-gate approach, which assesses impacts related to extraction and production until materials leave the factory "gate" to enter different products. Impacts occurring from further lifecycle phases are not included, as it is no longer possible to assign it to the individual material making up a product. Therefore, the figures presented are likely to be an underestimation.

Figure 12. Projections of global environmental impacts from different materials

Index=1 for the most polluting material in 2060



Note: Environmental impacts are presented for primary and secondary production combined. The lighter shading represents the value in 2015, while the full coloured area represents values in 2060.
Source: (OECD, 2019[1]).

5. A transition to a circular economy can lower resource demands and environmental impacts and contribute to the economic and social recovery

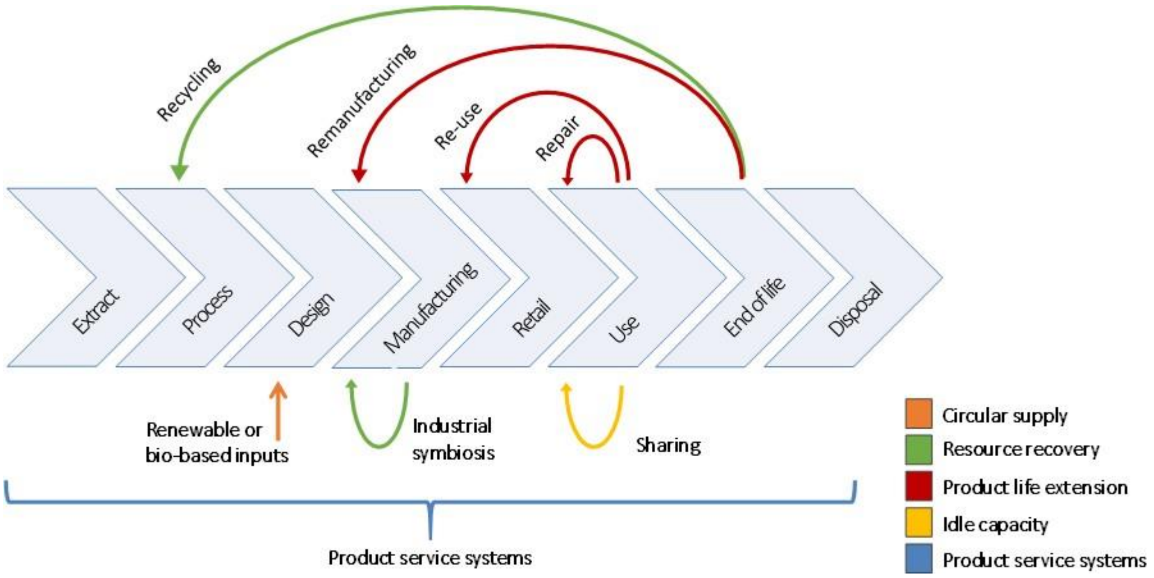
Increasing resource efficiency and moving to a more circular economy aims to maintain materials at their highest values and to keep products, components and materials in the economy for as long as possible, trying to eliminate waste and to reduce virgin resource inputs. Different processes of closing, slowing and narrowing resource loops can contribute to this aim in different ways (McCarthy, Dellink and Bibas, 2018[31]):

- *Closing resource loops* aims at minimising raw material extraction and waste output through improved end-of-life sorting, treatment and increased material recycling.
- *Slowing resource loops* stresses the need for fundamental changes in the economic system towards more durable products and extended lifespans through reuse, repair and remanufacture services.
- *Narrowing resource flows* aims at a more efficient use of natural resources, materials, and products along all phases of the value chain. This third part addresses the significant “structural” waste in current consumption patterns and underutilisation of assets (e.g. office space or private vehicles).

A number of circular business models can serve to close, slow and narrow resource flows and to decouple resource use from production (Figure 13). Sustainable product design and design for environment (DfE) are key to enable these circular business models:

- Circular supply models replace traditional material inputs derived from virgin resources with bio-based, renewable, or recovered materials, which reduces demand for virgin resource extraction in the long run.
- Resource recovery models recycle and reprocess waste into secondary raw materials, diverting waste from final disposal while also displacing the extraction and processing of virgin natural resources.
- Product life extension models, through reuse, repair or remanufacturing extend the use period of existing products, slow the flow of constituent materials through the economy, and reduce the rate of resource extraction and waste generation.
- Idle capacity or sharing models facilitate the sharing of under-utilised products and can therefore reduce demand for new products and their embedded raw materials.
- Product service system models, where services rather than products are marketed, improve incentives for green product design and more efficient product use, promoting a more sparing use of natural resources (OECD, 2019[32]).

Figure 13. Circular business models help close material loops and reduce material throughput



Source: (OECD, 2019[32])

Through these circular business models, a transition to a more circular economy can lead to substantial economic, environmental and social benefits:

An uptake of circular business models as well as investments in research and development of circular technologies can generate new economic growth through innovation (OECD, 2019[32]). Thereby, the circular economy can also contribute to the economic recovery from the recent COVID-19 crisis. Furthermore, making more efficient use of materials can lead to cost savings and increase the autonomy of resource-importing countries, especially for critical materials and minerals[4] (OECD, 2019[1]; Coulomb et al., 2015[33]).

Circular business models allow to mitigate environmental impacts throughout the value chain in various ways. For example, sharing existing assets can lower demands for new products. Recycling materials can substantially reduce environmental impacts compared to primary material production and reduces environmental pressures, as compared to alternative waste treatment options, such as landfilling or incineration. For example, the environmental impacts of recycled metals are estimated to be one order of magnitude lower compared to primary metals (OECD, 2019[32]). Furthermore, increased reuse and repair extends product lifespans and prevents waste generation. With more than two-thirds of the emissions linked to materials management, a transition to more circular economy can substantially contribute to meeting climate targets as outlined in the Paris Agreement.

A transition to a more circular economy can also have a small but positive net effect on employment, with employment gains in particular in waste and recycling sectors. Circularity can be expected to have a positive net effect on job creation, due to the fact that an economy favouring repair, maintenance, upgrading, remanufacturing, reuse and recycling of materials, tends to be more labour intensive than linear extraction and manufacturing processes (Wijkman and Skånberg, 2017[34]). Whilst the development and uptake of new circular business models and services can lead to new employment opportunities, some employment losses may be expected in resource intensive activities. The net employment effect of a

[4] Critical minerals refers to the group of non-renewable materials for which the risk of disruptions in supply is relatively high and for which supply disruptions will be associated with large economic impacts (Coulomb et al., 2015[33]).

circular economy transition will differ per country, depending on its economic structure and specialisation, but at the global level, macroeconomic models show that the circular economy transition could contribute to a slight increase of employment (Chateau and Mavroeidi, 2020[35]; Laubinger, Lanzi and Chateau, 2020[36]). As such, transitioning to a more circular economy can also help to mitigate negative employment effects, triggered by the COVID-19 crisis.

With benefits in economic, environmental and social domains, there is a strong rationale for G20 countries to advance the transition to a more circular economy. COVID-19 recovery packages that governments are currently putting in place, if well designed, can play an important role in realising these benefits.

6. Recent developments on resource efficiency and circular economy policies

During the last decade, principles of resource efficiency and materials circularity – including resource productivity, material recovery, sustainable materials management and the "3Rs" (i.e. reduce, reuse, recycle) – have received increased attention from the highest levels of government of many G20 countries and the G20 and G7 itself. They are also actively promoted by international organisations, including the OECD and the United Nations Environment Programme (UNEP), as well as the European Commission.

National and sub-national strategies and roadmaps are being developed

At the national level, a number of G20 countries developed national strategies, roadmaps and policy packages that address elements of resource productivity. These strategies and roadmaps lay out and support the implementation of resource productivity policies. Some countries focus primarily on waste management, reduction of littering and material recovery, whereas others include upstream aspects on resource efficiency and waste prevention (Table 2).

Several cities and subnational governments in G20 countries have also put forward roadmaps and strategies for the transition to the circular economy. Introducing a circular economy strategy in a city or in a region serves to build a vision, identify priorities and allocate financial resources to achieve these priorities. For example, the cities of Toronto (Canada), London (United Kingdom) and Paris (France) introduced circular economy strategies or roadmaps. Subnational governments such as Scotland and England (United Kingdom) also developed circular economy strategies and engaged with a variety of stakeholders for their implementation (OECD, 2020[37]) (Table 2).

Table 2. Selected examples of national, regional and local strategies for resource efficiency, waste management and the circular economy of G20 countries

Country	Year of introduction	Strategy name
Australia	2018	2018 National Waste Policy: Less waste, more resources
China	2008 2017	Law for the Promotion of the Circular Economy Circular Economy Policy Portfolio
France	2018	Circular Economy roadmap of France
Germany	2020	German Resource Efficiency Programme (ProgRess) III
India	2019	National Resource Efficiency Policy
Indonesia	2017 2018	Presidential Decree No.97/2017 on National Policy & Strategy on Management of Household Waste and household-like Waste (JAKSTRANAS) Presidential Decree No.83/2018 on Marine Debris Management (Plan of Action on Marine Plastic Debris 2017-2025)
Italy	2017	Towards a Model of Circular Economy for Italy
Japan	2018	4th Fundamental Plan for Establishing a Sound Material-Cycle Society
Korea	2018	Framework Act on Resource Circulation (FARC) & Master Plan on Resource Circulation
South Africa	2020	National Waste Management Strategy 2020
South Korea	2016	Framework Act on Resource Circulation
United States	2015	Sustainable Materials Management Action Plan
Region or City	**Year of introduction**	**Strategy name**
England (United Kingdom)	2018	Resources and waste strategy for England
Scotland (United Kingdom)	2016	Making Things Last A Circular Economy Strategy for Scotland
London	2017	London's Circular Economy Route Map

(United Kingdom)		
Nantes (France)	2018	Circular Economy Roadmap
Paris (France)	2017	Circular Economy Plan of Paris 2017 2020
Toronto (Canada)	2018	Circular Economy Procurement Implementation Plan and Framework

A number of high-profile multilateral initiatives affirm the importance of resource productivity and the circular economy at the international level. In the context of the G7 and G20, resource efficiency has been on the agenda for several years (Box 3). In the European Union, the Resource Efficiency Platform was established as well as a first Circular Economy Action Plan in 2015, followed by a new Circular Economy Action Plan, released in 2020, which forms one of the main building blocks of the European Green Deal and also acknowledges the role of cities in the transition. The OECD and UNEP's International Resource Panel (IRP) support these initiatives and provide important scientific assessments and policy guidance towards improving resource efficiency and the monitoring thereof.[5]

Box 3. Resource efficiency at the G20 and G7

At G7 and G20 meetings, resource efficiency has been on the agenda for several years:

The G7 has taken a series of initiatives on resource efficiency and the 3Rs, including the G7 Alliance on Resource Efficiency (G7 Leader's Declaration, 2015[38]), the Toyama Framework on Material Cycles (G7 Leaders' Declaration, 2016[39]) and the G7 Bologna Roadmap (G7 Leaders' Declaration, 2017[40]).

The G20 established a Resource Efficiency Dialogue in 2017 under the German presidency, which provides a platform for exchanging views, policy experiences and good practices on resource efficiency and calls for "broadening the knowledge base on global resource use and future resource needs" (G20 Leaders' Declaration, 2017[41]). Subsequent presidencies continued the Dialogue touching upon issues such as circular economy and finance and marine plastic litter (G20, 2019[42]).

In recent years, the topic of (marine) plastic litter, which has sustainable material and waste management policies at its core, has risen on the political agenda, with a number of initiatives and policy developments on multilateral and national levels (Box 4).

Box 4. The rise of plastics on the political agenda

The growing concern about the adverse environmental impacts of (marine) plastics litter has led to a number of high-profile multilateral and national initiatives specifically on increasing material efficiency, recovery and reducing environmental impacts related to plastics.

Marine plastics litter was introduced to the G20 in 2017 at the G20 Hamburg summit, with the adoption of the "G20 Action Plan on Marine Litter". In 2019, the "G20 Implementation Framework for Actions on Marine Plastic Litter" was established, as well as the "Osaka Blue Ocean Vision", which aims to reduce additional pollution by marine plastics litter to zero by 2050 through a comprehensive life-cycle approach. This Osaka Blue Ocean Vision has since been widely shared at various international fora and promoted as a common global vision (G20, 2020[43]).

In the EU, a plastics strategy was launched in 2018, which sets bold targets for plastics recycling quotas and recycled content requirements. In the G7, the issue of plastic waste and marine litter was first

[5] For example, in 2016 the OECD developed a Policy Guidance on Resource Efficiency for the G7 (OECD, 2016[72]).

included in the agenda in 2015 in the form of the G7 Action Plan to Reduce Marine Litter, and has remained in the spotlight during subsequent G7 presidencies (Government of Canada, 2020[44]). Furthermore, a number of countries have introduced plastic specific policies, such as levies and bans on single use plastic items, initiatives to improve plastic waste sorting and recycling.

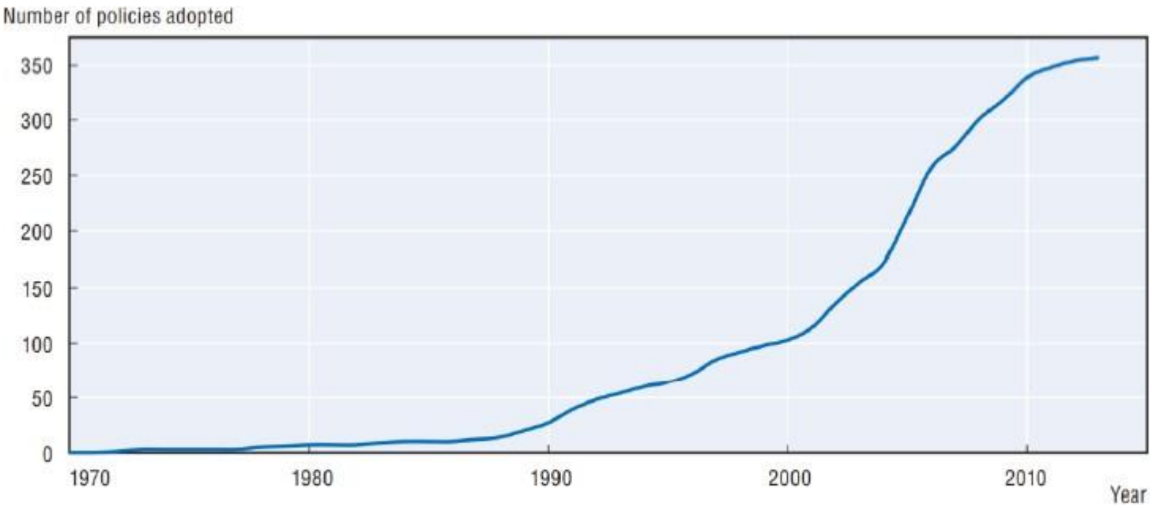
Sources: (G20, 2017[45]; G7, 2019[46]; European Commission, 2018[47])

G20 members use a mix of different policy instruments to increase resource efficiency

To implement these overarching plans, G20 countries are scaling up the use of existing and new policy instruments, including market, regulatory, education and information-based instruments, as well as public financial support and co-operation across value chains.

One of the most widespread and successful policy measures is Extended Producer Responsibility (EPR) (OECD, 2016[48]; OECD, 2001[49]). EPR relies on the polluter-pays principle, which encourages manufacturers to assume responsibility for the environmental impacts of their products throughout the whole product lifecycle. By internalising the end-of-life management costs of materials (i.e. those linked to collection and recycling), EPR represents an important tool to boost innovation and enhance resource efficiency. EPR schemes can include a variety of policy instruments, such as product taxes, recycling requirements, deposit-refund schemes, and disposal fees. EPR schemes have gained increasing popularity in the last decades (Figure 14) and they are currently in place in the majority of G20 countries. Whereas in most cases EPR focuses on packaging, electronic and electric equipment, batteries, tyres and end-of-life vehicles, in recent years some G20 countries have started widening the scope of their EPR systems to cover a wider array of products, including for example furniture and textiles. In addition, whilst EPR fees have usually been set on a per-unit or per-weight basis, countries such as France, Italy or Canada have worked towards more advanced EPR fee modulation to better instigate eco-design (OECD, forthcoming[50]).

Figure 14. Cumulative EPR adoption at the global level



Source: (OECD, 2016[48])

Another key instrument to facilitate the transition to a circular economy is green public procurement (GPP). GPP sets resource efficiency standards for suppliers and products purchased by the public sector, thus stimulating innovation, shaping consumption and production, and ultimately creating markets for greener products. GPP has the potential to introduce further criteria relevant to the circular economy, such as product lifespan or the quality of second hand or repaired products. Green public procurement can have a high impact. For instance, in OECD countries, government procurement accounts for one third of public expenditures and for 12% of GDP (OECD, 2016[51]). Particularly in sectors where public purchasers represent a large share of the market, such as construction, health services and public transport, GPP has a high potential.

Market instruments, such as taxes, subsidies, and tradable permit schemes, are widely used to enhance resource efficiency and incentivise the transition to a circular economy (OECD, 2021[52]). Virgin material taxes incentivise efficient resource use by increasing the cost of extracting and using natural resources and raw materials, while landfill taxes can play a key role in diverting waste flows from landfills. Environmentally-motivated subsidies can encourage increased materials productivity, besides incentivising materials re-use and recycling. Waste management can also benefit from pay-as-you-throw (PAYT) schemes, as well as cap-and-trade schemes, such as the tradable landfill permits scheme implemented in the United Kingdom. Economic instruments for the circular economy are in place in several G20 countries, however, in most cases, resource tax rates remain too low to effectively increase resource productivity (OECD, 2012[53]; OECD, 2021[52]).

Among regulatory instruments, recycling targets, product standards, recycled content requirements, lifetime warranties, bans and restrictions and deposit-refund systems (DRS) useful policies to increase resource efficiency. In recent years, minimum quality standards (e.g. for product design) and legal requirements on the reparability of products have attracted increasing political attention. For example, the EU End-of-life Vehicles Directive banned the use of hazardous materials in car manufacturing (e.g. ban on the use of cadmium, chromium, lead, and mercury) to improve recyclability (OECD, 2019[54]). The government of Scotland, United Kingdom, has introduced standards for reuse quality and for recognition of remanufactured products. In addition, recycling targets are a key instruments to raise recycling rates.

Furthermore, public information, consumer education, and awareness raising campaigns can help to foster behavioural change. For instance, environmental labels can steer consumer choices towards less environmentally harmful products. Examples of successful labelling schemes include the Nordic Swan Ecolabel (Denmark, Finland, Iceland, Norway, Sweden), Blauer Engel (Germany), the EU Ecolabel, and the EU Energy Label, as well as EPEAT (U.S.).

Other policy tools to steer resource productivity include education campaigns, public funding for research and development (R&D), voluntary agreements and other private sector initiatives. In recent years, new policy instruments have started to attract attention and have entered the process of policy planning in several countries. These include eco-design mandates, labelling requirements and schemes, the reform of environmentally harmful subsidies, and recycled content standards.

COVID-19 green recovery and the circular economy

The coronavirus pandemic and subsequent lockdown measures have caused severe short- and long-term effects on the macro-economy (OECD, 2020[55]). The COVID-19 crisis also had its own effect on the circular economy, with disruptions in recycling activities and changes in consumer and firm behaviour. Some recycling activities, such as manual sorting have temporarily come to a halt, border closures disrupted recycling supply chains and increased online shopping and take-away orders, as well as the regular use of personal protective equipment (PPE) have led to an increased consumption and waste generation from single-use plastic items (Paben, 2020[56]; Adyel, 2020[10]).

In reaction to the economic downturn, many countries launched a set of stimulus packages, to absorb the negative economic impacts. Most emphasised that these stimulus packages should lead to a “green recovery” from the pandemic, in alignment with other global challenges. However, recent OECD analysis finds that green measures are a small proportion (17%) of overall stimulus. Importantly, the green recovery measures announced so far include only limited concrete actions for resource efficiency, circular economy and waste management. Across the G20 membership[6], only around 1% of total funds committed to the COVID-19 recovery were estimated to address aspects of waste management and resource efficiency (OECD, 2021[57]).

The uptake of new circular business models can provide a means for economic recovery, which currently remains largely untapped due to a limited focus of recovery measures on the subject. Integrating resource efficiency measures into COVID-19 recovery measures more broadly can lead to positive environmental, as well as economic and social outcomes.

The COVID-19 crisis can also be an opportunity for cities to rethink urban policies towards more sustainable production and consumption patterns. The pandemic triggered initiatives that can also be beneficial for the circular economy, such as the extension of bike lanes, a focus on local food production or the establishment of food banks for people in need. This momentum can be used to further accelerate the transformation in cities and increase their resilience, in line with circular economy principles (OECD, 2021[58]).

[6] The OECD Green Recovery Database contains entries for all G20 countries, except Argentina, Russia and Saudi Arabia.

7. The role of cities towards the circular economy transition

Why are cities important in the transition to the circular economy?

Being the places where people live, work, consume and dispose of products, cities hold a key role in the transition to a circular economy. Megatrends such as climate change, demographic growth and urbanisation lead to reflections on how to improve resources efficiency and prevent waste generation. Cities represent almost two-thirds of global energy demand, produce up to 50% of solid waste and are responsible for 70% of greenhouse gas emissions (IEA, 2016[7]; World Bank, 2009[8]). In fast developing G20 countries, such as in Brazil, Russia, India, Indonesia, China, and South Africa (BRIICS), where urbanisation rates remain high and cities are expanding at a fast rate, there is a crucial need to anticipate and tackle the growth of raw material demand. In OECD countries, where much of the urban infrastructure is already built, the circular economy can offer opportunities for urban mining and industrial symbiosis.

Cities hold key competences on important sectors for the circular economy, such as waste management, water, urban planning and mobility. In the building sector, for example, cities can enforce regulation on commercial and residential buildings and operate public buildings to improve water and energy efficiency. In BRIICS countries, cities often build new urban infrastructure and engage in greenfield development. This can allow for leapfrogging opportunities if circular economy principles are applied early on in the planning and construction of new urban areas. Furthermore, solid waste management is commonly managed on municipal level and cities are key to improving the collection, treatment and recycling of waste. Cities also commonly control water management infrastructures and are well placed to increase water efficiency. Finally, cities are responsible to approving and managing spatial planning and land use. Through these levers, cities are well placed to encourage sustainable production and consumption patterns through a circular economy lens (OECD, 2020[37]).

Unlocking the potential of the circular economy in cities requires coordination across *people, policies and places* (see 3Ps Framework in Box 5). The circular economy is transformative as it implies a cultural shift towards different production and consumption pathways, new business and governance models (*people*). It requires a holistic and systemic approach that cuts across sectoral *policies*, and a functional approach that goes beyond the administrative boundaries of cities and closes, narrows and slows loops at the right scale (*places*).

Box 5. The 3Ps framework: people, policies, place

The 3Ps (people, policies and places) framework provides a conceptual framework to make circular economy happen in cities and regions. In particular:

- **People**: The circular economy implies shared responsibilities across different levels of government and stakeholders. Results from the OECD Survey on the Circular Economy in Cities and Regions carried out across 51 cities and regions in OECD countries[7] show that several stakeholder groups contribute to development and implementation of circular economy initiatives, such as: the business sector (80%), the scientific and academic sector (76%),

[7] The survey addressed 51 cities and regions from 21 OECD countries. It covers the following G20 countries: Australia, Canada, France, Germany, Italy, United Kingdom and United States. Additional countries include Belgium, Chile, Denmark, Finland, France, Germany, Italy, Latvia, the Netherlands, Norway, Portugal, Slovenia, Spain, Sweden and the United Kingdom (OECD, 2020[37]).

producers and citizens (73%), non-governmental organisations (NGOs) and suppliers (65%), service providers, designers and contractors (63%).

- **Polices:** The circular economy is systemic by nature and as such, policy-making requires a holistic approach across all sectors. Almost all the respondents of the OECD survey identified the waste sector as key for the circular economy (98%), followed by the built environment (75%), land use and spatial planning (70%), food and beverages and water and sanitation (65%), amongst others. The circular economy provides opportunities to foster complementarities across environmental, regional development, agricultural and industrial policies.
- **Places**: Circular economy related initiatives take place at various scales. They can vary from the micro-level, including a neighbourhood, to the metropolitan, regional and national levels. At the neighbourhood level, pilot projects can demonstrate innovative technologies but also stimulate and test the participation of citizens. But circular economy initiatives can also stretch beyond a cities boundary and connect to rural areas and a cities' hinterland, by involving local farmers and enabling the local procurement of food. For instance, the Municipalité Régionale de Comté des Sources (Canada) and the economic development organisation Synergie Estrie foster industrial symbiosis projects through the networking of businesses in the region. In Kitakyushu City (Japan), a food recycling loop between rural-urban areas has been established to use compost generated in urban areas as fertilisers in rural areas or as energy source.

Source: (OECD, 2020[37])

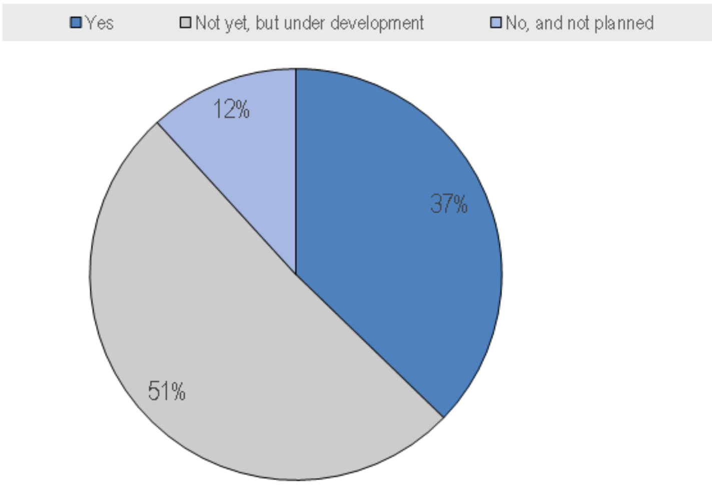
The circular economy in cities: the state of the art

There is substantial momentum to transition to a more circular economy on city-level and an increasing number of cities are implementing circular economy strategies. According to the recent OECD survey on the Circular Economy in Cities and Regions, 37% of the surveyed cities and regions put in place initiatives dedicated to the circular economy, including strategies, plans, programmes or roadmaps, 51% have plans to develop such a strategy and only 12% indicated to not have plans to develop one (Figure 15).

Major drivers for transitioning to a circular economy are environmental (climate change, 73%), institutional (global agendas, 52%) and socioeconomic (changing economic conditions, 51%). Additionally, the circular economy transition is driven by job creations (47%), private sector initiatives (46%), new business models (43%), technical developments (43%) and research and development (R&D) (41%) (OECD, 2020[37]).

For various cities, the first attempt to include circular economy principles in their policies and strategies relate to waste and resource management plans. For example, the waste management corporation of Munich (Germany) has transformed its core business focusing on the collection and management of household waste into a resource-efficient circular economy approach with focus on material recovery. Also the City of Toronto (Canada) included circular economy principles in its Long Term Waste Management Strategy.

Figure 15. Share of surveyed cities and regions with circular economy initiatives in place



Note: Results based on the OECD survey addressing a sample of 51 cities and regions from 21 OECD countries (including seven G20 countries) that responded “Yes”, “Not yet, but under development” and “No, and not planned” to the question on the existence of a circular economy initiative (e.g. a strategy, plan, programme, road map, etc.), intended as a set of actions designed to achieve circular economy long-term goals.
Source: (OECD, 2020[37])

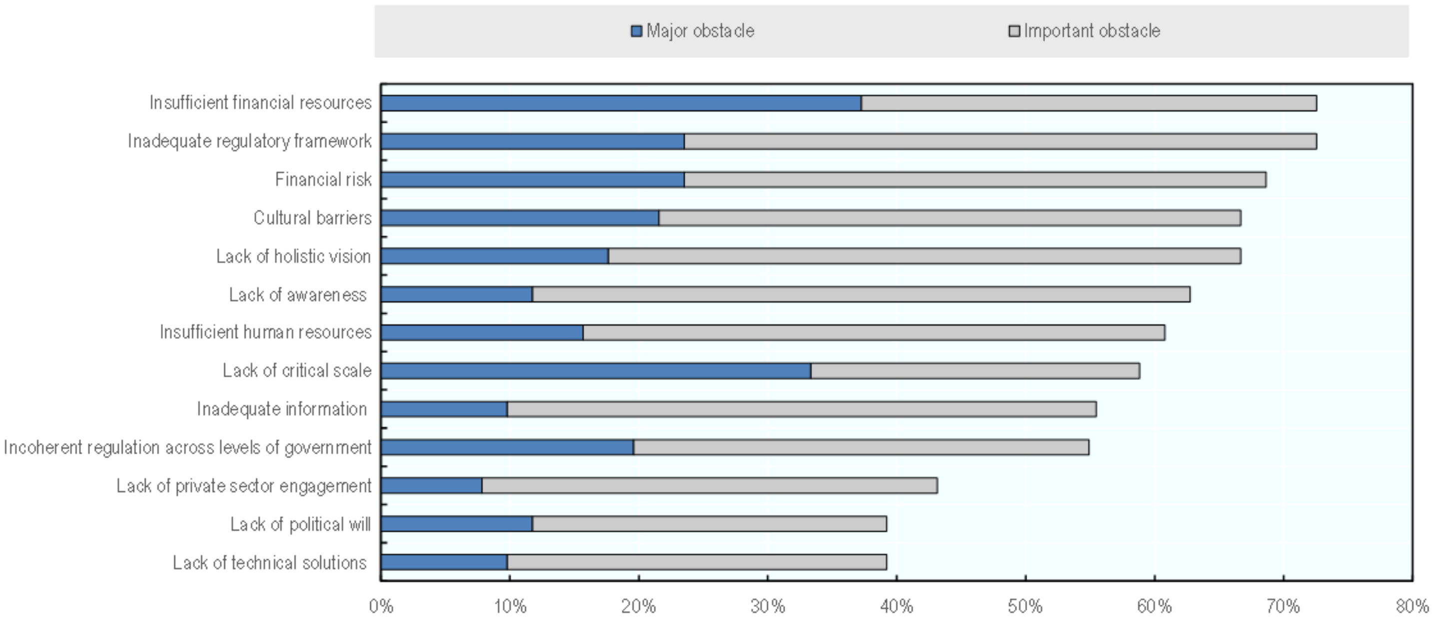
There remains room to further advance circular economy initiatives in cities of the G20. According to the OECD survey, most cities situate themselves at the initial phase of a transition to a circular economy. The majority of the surveyed cities (57%) consider themselves as “newcomers” that recognise the relevance and potential of the circular economy but are still exploring options for implementation. Only 10% of surveyed cities defined themselves as “advanced” and having developed strategies or roadmaps and engage multiple stakeholders. 39% of surveyed cities consider their circular economy policies “in progress’, based on *ad hoc* initiatives. Only 4% described the transition towards the circular economy as “not in place” (OECD, 2019[59]).

In BRIICS countries, the development of a circular economy at the urban level sees different approaches and levels of implementation. In many countries, the approach focuses on waste management, but holds potential in sectors such as building and construction. China is seen as a leader in the circular economy among the BRIICS countries. The 2009 “Circular Economy Promotion Law” provided the main national-level framework for pursuing the circular economy. In 2017, the “Circular Development Leading Action Plan” stressed opportunities to integrate circular economy principles at the design stage of products and to develop new circular economy business models. Cities in China can contribute to the transition towards the circular economy as potential incubators of innovative circular solutions at scale (EMF, 2018[60]). In particular, Chinese cities would allow large-scale experiments and upscaling of a circular economy in areas such as e-mobility and car sharing, infrastructure development and housing, food and nutrition, textiles and fashion (Ekins et al., 2019[61]). In Brazil and India, circular opportunities are prevalent in the building and construction sector. In Brazil, the building sector represents 7% of GDP and 9% of the job market and more than half of the waste going to landfill in Brazilian cities originates from demolition and construction (EMF, 2017[62]). Similarly, in India, the construction sector generates more than 8% of GDP and is expected to expand further, to meet the demand for new housing. Circular economy criteria applied to buildings can help to create resilient cities and can allow for material circulation and reuse of components at the end of a building’s life (EMF, 2016[63]).

Financial, regulatory, policy, awareness and capacity gaps currently hamper the transition to the circular economy (Figure 16):

- Funding gaps: The transition towards a circular economy requires investments and adequate incentives. Cities and regions responding to the OECD survey face constraints in terms of insufficient financial resources (73%), financial risks (69%), lack of critical scale for business and investments (59%), and lack of private sector engagement (43%).
- Regulatory gaps: Inadequate regulatory frameworks and incoherent regulations across levels of government represent a challenge for 73% and 55% of the surveyed cities and regions respectively.
- Policy gaps: A lack of holistic vision is an obstacle for 67% of surveyed cities and regions. This can be due to poor leadership and co-ordination. Other policy gaps concern the lack of political will (39%).
- Awareness gaps: Cultural barriers represent a challenge for 67% of surveyed cities and regions along with a lack of awareness (63%) and inadequate or insufficient information (55%) for policymakers to take decisions, businesses to innovate and residents to embrace sustainable consumption patterns.
- Capacity gaps: Lack of human resources and of technical solutions represent a challenge for 61% and 39% of surveyed cities and regions.

Figure 16. Main obstacles to the circular economy in surveyed cities and regions



Note: Results based on a sample of 51 respondents that indicated obstacles as being "Major" and "Important".
Source: (OECD, 2020[37])

Several cities in G20 countries set up financial, economic, regulatory tools and capacity building programmes to advance the circular economy transition:

- The financial instruments employed in cities include loans, grants, revolving funds, venture capital and growing capital (OECD, 2020[37]). For example, the London Waste and Recycling Board (LWARB) in the United Kingdom supports circular economy businesses through the "Circular Economy Business Support Programme", a venture capital fund supporting SMEs in scaling up their circular economy businesses.

- A range of economic instruments such as tax rebates, environmental pollution taxes and differentiated tariffs incentivise or discourage specific behaviours and business activities. For example, the City of Milan (Italy) introduced a 20% discount on waste taxes for businesses that donate their food surplus to charity.
- Some cities also introduced circular economy related requirements in public procurement and public tenders. For example, the City Kitakyushu (Japan) promotes the use of recycled materials and the reuse and repair of uniforms and work-clothes through procurement. In the city of San Francisco (U.S.), all carpets installed in public buildings are required to have a Cradle-To-Cradle Certified™ Silver rating or higher.
- Cities are also implementing capacity-building initiatives. Inside their own administration capacity building can for instance help to improve public procurement. But capacity building programmes also exist for other stakeholders such as businesses, entrepreneurs or start-ups. For instance, Mexico City (Mexico) launched a training programme for technicians for the installation and maintenance of solar systems, in the context of its Solar City program (U20, 2020[64]). Co-operation between cities can also be useful to enhance capacities and exchange good practices. For instance, Zero Waste Scotland co-ordinates the development of regional projects and enables the exchange of good practices across cities and regions in Scotland, including Edinburgh, Glasgow, North East Scotland and Tayside.

Results from the OECD survey show that 85% of respondents employ new circular business models (OECD, 2020[37]). Collaborative consumption and production models such as the sharing economy or crowdfunding have been introduced by several cities such as Milan (Italy) or Paris (France). Product-service-system models (PSS) have also been introduced where consumers pay for a service rather than buying the product itself. For instance, public school buildings in the municipality of Bollnäs (Sweden), or the Dutch Schiphol Airport rent light as a service, providing an incentive for the service provider to maximise durability and energy efficiency of the lighting equipment.

Circular economy strategies and projects in surveyed cities are often based on experimentation and pilots, allowing to test new technologies, foster innovation and raise awareness. For example, in Riyadh (Saudi Arabia) the Home of Innovation Demonstration Villa Project explores the construction of a sustainable dwelling with commercially available materials in conformity with Saudi building codes, whilst leading to a 40% reduction in energy and potable water use (U20, 2020[64]).

Digitalisation can also help to foster specific actions foreseen in circular economy initiatives at the local and regional scale. For example, the City of Paris (France) developed an online collaborative platform that brings together initiatives, tools, news and events relevant to the circular economy and enables stakeholders to connect and share knowledge. The City of Phoenix (U.S.) developed the “Recycle Right Wizard” website, which provides recycling information for citizens. The City of São Paulo (Brazil) set up a digital tool that connects large waste generators with transportation, composting and treatment centres, through smart data to allow for traceability and monitoring (U20, 2020[64]).

Improving resource efficiency in the built environment of cities

Applying circular economy criteria to the building sector implies rethinking upstream and downstream processes with the scope of maximising resource use and minimising waste production. Construction boom in emerging economies, especially China, will be a major driver for increased materials use in the coming years (OECD, 2019[27]). The circular economy can play an important role in reducing materials use for construction projects, as well as reducing GHG emissions and energy and water demand of existing buildings (Box 2).

A circular urban building sector considers the entire life cycle, from the designing and construction of buildings, their use, to their end of life. Collaboration between designers, constructors, contractors, real estate investors, suppliers and owners can enable opportunities for resource efficiency. The key phases of a circular building are planning, design, construction, operation and end of current life.

- Planning a building in a circular way implies considering circular economy aspects in its entire life cycle from improving the environmental performance of buildings, to conceive modular buildings that allow for reuse and/or reassembly of building components and materials. It also implies to plan new urban scenarios in line with the opportunities to regenerate natural systems, including vertical gardens, urban agriculture and green roofs.
- A circular design pays particular attention to the choice of materials, the consumption of resources such as water and energy, the reduction of waste and the possibility to reuse building components. For example, to help the application of circular economy principles in the design of buildings, the Public Waste Agency of Flanders in Belgium (OVAM), the Walloon Public Service (SPW) and the Brussels Environment Agency (Brussels Environment) developed a "Tool to Optimise the Total Environmental Impact of Materials (TOTEM)". TOTEM is an online open-access calculation tool aimed at supporting architects, designers and builders in improving material and energy performance of buildings and at assessing the environmental impact of building materials (Wille, 2013[65])
- In the construction phase, circular economy principles can be applied to identify more sustainable materials and to minimise the variety of the materials used. As well, improving data collection on the construction materials used in a building can enable reuse in the future. Building passports provide constructors and policymakers with information on materials embedded in the building stock and can create a database that enables urban mining at the end of a building's life (Cradle to Cradle Products Innovation Institute, 2019[66]).
- The operation phase can include circular solutions for the use of renewable energy and new technologies to improve resource efficiency in buildings. For example, the City of Paris (France) recovers heat from wastewater and uses it for the heating and cooling in public buildings. Paris also developed a network of non-potable water taps for cleaning purposes, to optimise drinking water use.
- At a building's end of life, there are opportunities for entire buildings or their components and materials to be repurposed or reused. This can include repurposing an existing asset, materials and components without applying significant changes and transformations and maintaining the same location, reusing existing assets for the same purpose, but in a different location, or reusing materials and components of existing assets in the same and different locations (Stronati and Berry, 2018[67]).

8. Towards a G20 policy vision on resource efficiency

Whereas policy responses to address resource efficiency and the circular economy have already emerged, they have been insufficient to curb the environmental impacts linked to materials consumption. Further and stronger policy action is needed to slow down the growth of materials use, improve the share of materials that are kept in the economy, and change the materials mix towards less toxic and more environmentally-efficient materials.

G20 members may want to develop their policies according to four principles in order to achieve these objectives:

- Promote resource efficiency throughout the full lifecycle of products;
- Align sectoral policies and COVID-19 recovery packages with resource efficiency objectives;
- Strengthen policy development through better data and indicators; and
- Enhance international co-operation.

In addition, given the diversity of countries in the G20, each country will need to assess their specific context and determine appropriate policy approaches and priorities for their transition from waste to resource, which can be structured along different phases. These phases are not strictly sequential and may overlap, but can help to identify policy priorities in a given context.

Finally, cities as key proponents of the circular economy transition are needed to promote, facilitate and enable circular activities on their territories in order to ensure that national level measures lead to effective implementation on the ground.

Promote resource efficiency throughout the full lifecycle of products

Resource efficiency policies should target all stages of materials lifecycle, namely material extraction, transport, manufacturing, consumption, recycling and disposal. Focusing on only one stage of a product's lifecycle risks to shift the burden to other stages, without reducing the overall environmental impacts (OECD, 2016[51]; OECD, 2021[52]). However, one of the main challenges to integrated lifecycle approaches is that material lifecycles and their impacts often involve a multitude of actors and extend across political and geographic boundaries.

To promote resource efficiency throughout the whole lifecycle of materials, governments need to enhance policy coherence across economic sectors, jurisdictions and all stages of the value chain, creating a coherent set of incentives for all relevant stakeholders. Strengthened policy coherence, together with increased coordination among all relevant stakeholders, can effectively counterbalance the increasing fragmentation of the global value chain. In addition, undertaking thorough lifecycle analyses can help to better understand the variety of environmental impacts occurring at different stages of materials use. It is important to consider all the environmental trade-offs among materials and their impacts, in order not to shift the environmental burden from one pressure to another.

Measures to promote resource efficiency throughout the lifecycle can include EPR schemes, GPP, and multi-stakeholder partnerships. Whereas EPR schemes have been widely adopted in many countries, further efforts are needed to broaden their scope (e.g. include new waste streams and stronger incentives for eco-design), strengthen their enforcement, and ensure that they operate in a transparent and accountable way. Integrating resource efficiency objectives in green public procurement schemes can be another successful way to improve the effectiveness of GPP systems and to encourage resource efficiency along a product's lifecycle. Finally, establishing and incentivising partnerships with businesses and other stakeholders involved in different stages of the value chain can improve coordination, while stimulating a lifecycle approach. Partnerships have a variety of additional benefits, as they enrich human capital, facilitate technology and knowledge transfer, and favour the diffusion of best practices. These efforts can be further supported by facilitating the availability of information on materials, material content and environmental impacts across value chains.

Altogether, policy mixes targeting the circular economy should provide incentives for narrowing, slowing and closing material loops. This includes promoting a more efficient use of natural resources, materials and products and incentivising the production and use of more durable products. Increased material recycling, reuse, repair and remanufacturing, together with improved end-of-life sorting and treatment, are key elements in the transition towards a more circular economy.

Align sectoral policies and COVID-19 recovery measures with resource efficiency objectives

Policy misalignments, perverse incentives and conflicting priorities often represent an obstacle to the implementation of effective resource efficiency policies. Policy misalignments are often linked to inefficient incentives for transitioning to a circular economy across policy communities, levels of government, and stakeholders. For example, trade restrictions (e.g. on exported raw materials, used goods, and environmental goods and services) can weaken markets for secondary materials and lower opportunities for material reuse and recovery, and hamper resource efficiency efforts in other.

National and international policy frameworks need to mainstream resource efficiency and to treat the transition to the circular economy as an overarching economic policy challenge. Cross-cutting policies, such as innovation, investment and education strategies, should integrate resource efficiency objectives. Supporting innovation in small and medium enterprises (SMEs) can help to achieve decoupling of materials use from economic growth, while mainstreaming resource efficiency into investment plans and strategies can support a more resource-efficient and low-carbon development. Assessing the set of skills required for the transition to the circular economy will help to adjust education and training programmes.

Importantly COVID-19 economic recovery should be aligned with resource efficiency goals (Box 6).

Box 6. Mainstream resource efficiency in COVID-19 recovery packages

In response to the COVID-19 pandemic, many countries were quick to commit to a "green recovery" through stimulus packages of unprecedented scale. Of the recovery measures announced so far, only a small share (approximately 1% of total funds) incorporates aspects of resource efficiency and waste management (OECD, 2021[57]).

The circular economy can provide a means to economic recovery. Yet, for this to happen, resource efficiency objectives need to be more mainstreamed into COVID-19 recovery packages.

Resource efficiency objectives should also be integrated in sectoral policy domains, with a particular focus on the most resource-consuming industries, such as agriculture, energy and transport. Aligning sectoral policies with resource efficiency principles is an effective tool to ensure coherent policy action and to effectively prevent and correct potential misalignments in the policy framework. At the same time, governments could also seek opportunities to exploit synergies across different policy objectives. For example, as the extraction, processing and disposal of raw materials are responsible for large volumes of greenhouse gas emissions, policies addressing resource efficiency could have significant climate co-benefits, contributing to countries' Nationally Determined Contributions (NDCs) and scaling up efforts to keep the average rise in temperatures well below 2 degrees.

Strengthen policy development through better data and indicators

To attain resource efficiency and circular economy objectives, it is fundamental to ensure the availability of accurate and reliable data. Evidence on material flows, resource efficiency and the costs of environmental impacts is necessary to build the case for sustainable materials management and to support policy design and implementation. However, incomplete datasets and significant data gaps (e.g. on international material flows, material flows across industries, and recyclable materials) hamper policy development. Data comparability is an additional challenge, as information is often collected on the basis of definitions and methodologies that are inconsistent across countries.

Countries should carefully assess their data needs and develop data systems that ensure the availability, quality and consistency of information, at national level, as well as in collaboration with other countries. Existing data gaps that need to be addressed include for example information on unused materials, secondary raw materials, recyclables, reuse, refurbishment and remanufacturing, urban mining, harmful substances, waste flows, as well as the uptake of circular business models and the indirect materials flows associated to international trade.

Furthermore, countries should develop effective metrics and indicators to monitor the different dimensions of materials use and track the progress and effectiveness of policy measures. In particular, countries could make additional efforts in tracking progress with regards to information on resource use and productivity, material stocks and flows, and decoupling trends.

Finally, it is fundamental to monitor and consider all the impacts of materials use, as well as their trade-offs and costs. For example, the substitution of one material with another might improve resource productivity while worsening the overall environmental impacts. Similarly, the socioeconomic impacts of materials use should be considered too, taking into account distributional and employment implications, such as for example employment levels and job quality.

In addition to developing sound data systems, governments should invest in capacity building to strengthen their ability to analyse material flows and resulting environmental and socioeconomic impacts. In this context, governments could also engage in international efforts to help strengthening developing countries' data and analytical capacity.

Enhance international co-operation

Whilst global supply chains have led to significant resource efficiency improvements, the increasing globalisation of our economy has also created new issues associated with increased complexity and lack of transparency. In light of increasing transboundary flows of resources, products and waste, international co-operation is necessary to ensure policy coordination and sustained benefits for all. The G20, which is accounting for 75% of global trade (G20, 2021[4]), has an important role to play to help ensure that trade and global value chains lead to improved resource efficiency.

Policy action at the international level is well placed to address challenges to resource efficiency in supply chains. For example, trade restrictions on raw materials and used products affect the efficiency with which materials are used, while other barriers to trade can hinder the diffusion of best available technologies (BAT) across countries. At the same time, international efforts can support companies in managing their supply chains, thus facilitating the integration of resource efficiency considerations in global value chains.

International co-operation can also help to improve and harmonise environmental labelling and information schemes. Facilitating the multilateral recognition of national or regional schemes would ensure the adequate stringency of environmental standards and ease compliance by producers. International co-operation could also help improving information gaps on resource efficiency and the circular economy (i.e. develop indicators and collect data on primary and secondary material flows and on existing stocks of natural resources), harmonising methodologies and ensuring the compatibility of data.

Finally, international coordination could support the systematic mainstreaming of resource efficiency in Official Development Assistance (ODA). To date, a relatively small share of ODA from G20 countries that are also members of the OECD's Development Assistance Committee is earmarked for purposes of resource efficiency or waste management. Significant effects could be achieved if resource efficiency was mainstreamed further into ODA (Box 7). ODA can contribute to effective capacity development and technology transfer. Aligning development finance with resource productivity goals would also provide an opportunity to reduce the burden generated by the increasing outsourcing of production.

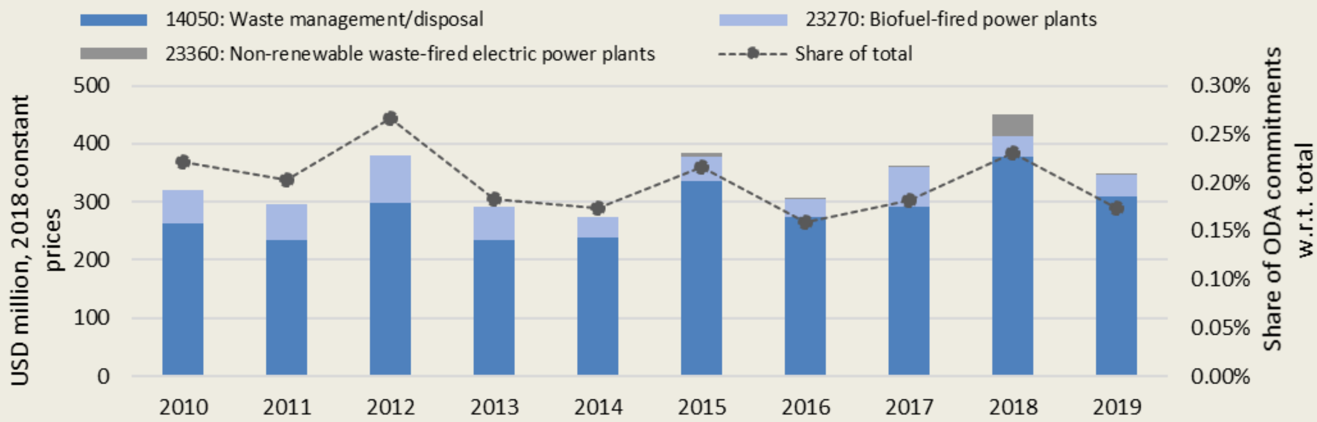
Box 7. Significant effects could be achieved if resource efficiency was mainstreamed into ODA more systematically

A lack of financing or insufficient technical knowledge or capacity are common barriers for setting up or extending waste services in less developed countries or for implementing resource efficiency policies or initiatives. In addition, many of the environmental and health impacts associated with illegal dumping and burning of waste, in particular hazardous waste, can be alleviated with formal waste collection and treatment services that are accessible and affordable for all.

Official Development Assistance that is targeted at these purposes can lead to cost-effective environmental outcomes. Technical assistance and capacity development can identify and realise "low-hanging fruits" for resource efficiency improvements in global value chains. Development co-operation can also contribute to reducing the "ecological backpack" caused by the increased imports of processed goods, and to mitigating the negative effects of production relocation.

To date, a relatively small share of ODA from G20 countries that are also members of the OECD's Development Assistance Committee is earmarked for purposes of resource efficiency or waste management. In 2019, ODA specifically earmarked for these purposes accounted for around USD 350 million, less than 0.2% of the overall ODA commitment budget spent by G20 DAC countries. No significant trend is notable over the past years. Between 2010 and 2019, ODA for resource efficiency and waste purposes have remained at small shares of around 0.15-0.25% of total ODA commitments (Figure 17).

Figure 17. The share of ODA commitments by G20 donor countries for the purpose of resource efficiency and waste projects is low



Note: Not all G20 countries are registered as official donors in the Creditor Reporting System. G20 donors considered in this graph include: Australia, Canada, France, Germany, Italy, Japan, Korea, Russia, Saudi Arabia, Turkey, United Kingdom, United States, as well as EU Institutions.
Source: Authors' calculations based on (OECD, 2021[68]) *Creditor Reporting System* (database)

Transitioning to a more circular economy is a phased approach where a country's context shapes policy priorities

Resource efficiency and waste challenges differ across G20 countries, depending on a country's context, economic structure and stage of development. Specific contexts and local circumstances lead to different priority actions and objectives in different G20 countries. For example, in emerging economies, a priority may be to phase out uncontrolled disposal (open burning and dumping) and extend controlled waste collection and management to the entire population in order to improve public health. In more developed economies, where basic waste collection is already in place, the management of hazardous and non-hazardous waste is usually carried-out in an environmentally sound manner, and the priority is to increase material recovery as well as to reduce waste generation.

As such, transitioning to a more circular economy is a phased approach, along a hierarchy of different objectives that aim to improve public health, mitigate environmental impacts from disposal and facilitate environmental improvements through material efficiency and recovery. The UNEP Global Waste Management Outlook describes several phases, moving from "waste management" to "resource management" (Figure 18) (UNEP, 2015[69]). Whilst these phases overlap and are not strictly sequential, they can provide an indication for policy-makers on policy priorities in a given context.

Figure 18. Waste management hierarchy and complementary policy actions

Source: (UNEP, 2015[69])

First, to protect the environment and public health, waste needs to be properly managed. To eliminate uncontrolled dumping and open burning, adequate, safe and affordable waste collection services are essential prerequisites. This includes formalising the informal waste sector or, where relevant, integrating informal waste services into formal waste management systems. The aim is to phase out uncontrolled disposal and to divert waste towards controlled, state-of-the-art landfills to reduce harmful impacts on public health.

Second, waste classified as "hazardous" requires special attention. Improper disposal, dumping or leakage of this waste can lead to severe impacts on the environment and human health. All G20 countries are producing hazardous waste that requires special attention. For instance, in the context of the COVID-19 pandemic, hazardous waste of the healthcare sector (e.g. infectious, pathological, radioactive or genotoxic waste, pharmaceutical waste and sharps) has surged (Das et al., 2021[70]). Inadequate and inappropriate handling of such wastes can have serious environmental and public health consequences and should thus be a key concern for G20 countries.

Third, where key public health risks have been mitigated through proper collection and environmentally sound treatment of wastes, countries need to start implementing a materials cycle to shift away from disposal and increase material recovery. Separate collection at source and improved sorting facilities are required to increase material recovery and recycling. These activities increase waste management costs, but can also lead to significant environmental benefits. Once material recovery is maximised, residual waste that cannot be further recycled, can be incinerated in environmentally sound energy recovery facilities. This also allows to minimise the volume of waste that is landfilled.

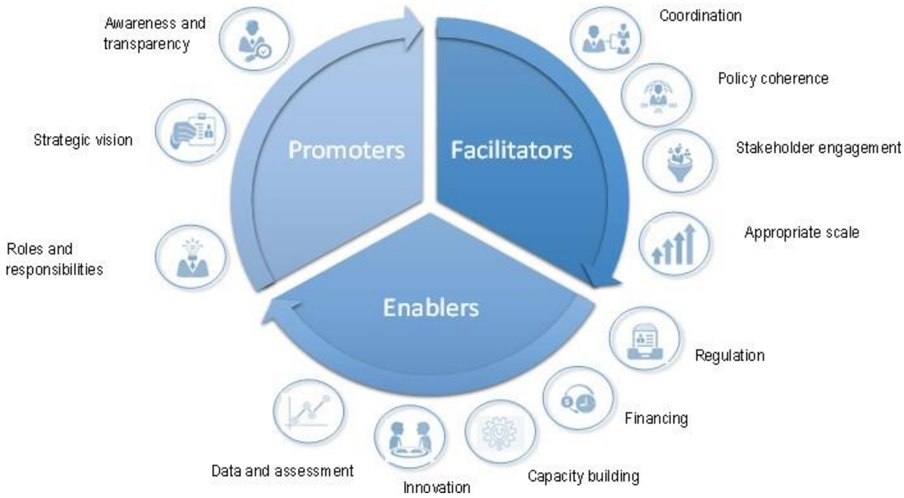
Fourth, whilst increasing material recovery at the end of the product lifecycle, countries also need to close "higher-value material and product loops" that enable retention of material values at earlier stages of the lifecycle. Tackling the issue at the source and target upstream lifecycle stages that prevent products from becoming waste and leads to more sustainable consumption and production is in most cases preferable from a lifecycle point of view. Governments should thus work towards product lifespan maximisation and encourage reuse and repair, where this is environmentally preferable. Often, better product designs will be needed to achieve these objectives.

Policy guidance for circular cities: promoting, facilitating and enabling the circular economy

Cities can act simultaneously as promoters, facilitators and enablers of the circular economy. This can be done in a shared responsibility with national government and stakeholders. As promoters of the circular economy, cities can act as a role model for citizens, business and other stakeholders, providing clear information and introducing goals and targets within long term circular economy strategies. As facilitators, cities can facilitate connections and dialogue across stakeholders and offer soft and hard infrastructures for new circular businesses. As enablers, cities can create the enabling governance conditions for the transition to a circular economy to happen and the uptake of circular economy business models.

The OECD created a "Checklist for Action" based on twelve key governance dimensions that can serve as guidance for governments to act as promoters, facilitators and enablers of the circular economy (Figure 19). The checklist was designed to be used by cities, but it can also be applicable at other levels of government.

Figure 19. The governance of the circular economy in cities and regions: A Checklist for Action



Source: (OECD, 2020[37])

In order to *promote* the circular economy, cities can define roles and responsibilities and lead by example, develop circular economy strategies including clear goals and actions to achieve them, raise awareness on circular economy, guarantee transparency and enhance trust:

- Roles and responsibilities should be defined to clarify who does what in policymaking and implementation within the circular economy transition. Certain cities created dedicated offices to coordinate circular economy related activities. In others, responsibilities are attributed to waste management, environmental or urban planning departments. Importantly, horizontal coordination across municipal departments is needed to enhance policy coherence. Cities can also lead by example, through introducing waste prevention measures, promoting the use of secondary materials, adopting circular business models or establishing circular economy criteria in public procurement.
- Developing a circular economy strategy with clear goals and actions is fundamental to build a robust vision, identify priorities and allocate financial resources. A clear vision for the circular economy can address the fragmentation of existing initiatives and ensure continuity beyond political cycles. An urban circular economy strategy can be based on: 1) the analysis of stock and flows of materials and energy; 2) the mapping of existing related initiatives; 3) clear and achievable goals, actions and expected outcomes and results; 4) the analysis and allocation of budget and resources; 5) a consensus and common vision among relevant stakeholders based on a shared understanding and co-creation process; 6) an effective monitoring and evaluation framework.
- Practices enhancing transparency and information can overcome cultural obstacles in recycling and the use of secondary materials, facilitate co-operation of companies across the value chain, increase social acceptance and lead to more responsible choices on circular products and services. Promoting a circular economy culture can be done through communication campaigns, dedicated websites, knowledge sharing events and the use of social media. For example, the London Waste and Recycling Board (LWARB) in the United Kingdom recruited ambassadors for the circular economy to share information on the benefits of the circular economy for each economic sector (London Waste and Recycling Board, 2017[71]). Certificates, labels and awards can enhance trust in the circular economy benefits and solutions, and lead to more conscious production and consumption choices.

Cities can play the role of *facilitators* for the circular economy. They can implement effective multi-level governance coordination mechanisms, foster policy coherence and facilitate stakeholder engagement and collaboration between public sector, businesses and not-for-profit actors:

Co-ordination among different levels of government is important to address circular economy related issues effectively, align objectives and actions and avoid asymmetries or lack of information between the actors at local, regional and national levels. Co-ordination on the city level can be implemented through the introduction of specific co-ordinating bodies in public administration, the organisation of ad hoc meetings for city-province-region-state co-ordination, setting up of common databases and information systems or contracts/deals with the national government as tools for dialogue, for experimenting, empowering and learning. For example, the City of Toronto, Canada, created a Cross-Divisional Circular Economy Working Group comprising 11 divisions, with the scope to co-ordinate and enhance the capacity of the city divisions in implementing circular economy initiatives.

- The circular economy is systemic by nature and includes a variety of actors, sectors and goals. As such, for the circular economy to be effective, it requires integration across policies and plans (e.g. regional development, environmental, climate, mobility and land use, agricultural and industrial). To date, these sectoral policies have been often developed in silos.
- Local and regional authorities can foster synergies amongst public actors, non-for-profit organisations, knowledge institutions and businesses by facilitating the exchange of relevant information and experiences and engaging stakeholders. For example, cities can identify possible pilots and experimentations that would involve R&D and university departments, based on the needs of developing innovative urban solutions for mobility, tourism, food, waste, or the bioeconomy.
- Cities and regions can facilitate the creation of opportunities across urban and rural areas, as well at the micro level (e.g. neighbour or districts). For example, the City of Kitakyushu (Japan) introduced a food-recycling loop in which the compost produced by food-waste generated in urban areas is used as fertiliser in rural areas.

Cities can play the role of *enablers* of the circular economy transition by providing conditions for circular business models to thrive. Cities can introduce specific regulation, mobilise and allocate financial resources, develop training programmes, support business development and innovation, generate information systems and assess achievements of policies and strategies' goals and results:

- The transition to the circular economy requires conducive regulation in key sectors such as waste, water, food and building and construction. Identifying available tools (such as specific requirements for land use), environmental permits (e.g. for decentralised water, waste and energy systems) and regulation for pilot projects would clarify potential regulatory uncertainties across different legal entities, gaps and future needs.
- Cities can facilitate the access to finance. According to available funding options and budget capabilities, local and regional authorities can support circular businesses by using a range of financial instruments, from grants to venture capital. For example, in the United Kingdom, the "Circular Economy Business Support Programme" was created, a venture capital and growth capital fund that supports circular businesses.
- Training programmes can address public administrations, as well as private sector and civil society. Training can improve the capacities to address technical issues in specific sectors, to draft, launch and implement circular economy strategies, or to green public procurement. Experimentation and pilot projects can create new knowledge and information and improve capacities both in the public and private sectors. Training can also support entrepreneurs and employees to improve their knowledge on the circular economy opportunities and to succeed in circular economy projects. The

Glasgow Chamber of Commerce (United Kingdom) organised workshops and events on capacity building and good practices in context of the circular economy.

- Cities can introduce specific initiatives to support market innovation and business development. For instance, the start-up in Residence (San Francisco, United States) connects start-ups and businesses to develop solutions to the city's problems through transparent selection processes. Local and regional incubators can also promote innovative circular economy projects.
- Data can allow public authorities and businesses to improve policymaking and implementation of the circular economy. Data can also support the monitoring and evaluation of policies, programmes and strategies. Cities can collect and process environmental data, such as data on empty buildings, materials used for construction and waste streams, as well as data on existing circular economy initiatives. Digitalisation plays an important role in data collection and processing.

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Focus 5:

Policy Enablers to accelerate the Circular Economy

2023 Fiscal Review Committee:

wbcsd

Policy enablers to accelerate the circular economy

Scaling up actions across regions and stakeholders

NAVIGANT

Contents

1 Background

Systemic change is crucial to the continued pursuit of sustainable growth and development.

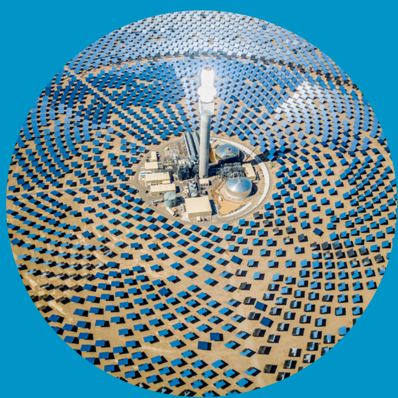
The world is facing global challenges and constraints due to resource depletion, wasteful production and consumption, and the rising impacts of climate change. Companies extract more than 60 billion tonnes of raw materials per year – or 22 kilograms per person per day – to support economic activities.[1] Over half of global greenhouse gas emissions come from material extraction and production.[2,3] Addressing the recovery and reuse of resources, product lifetime, and circular design are increasingly urgent causes. The transition to a circular economy can help tackle these challenges through five business models – circular value chains, lifetime extension/shelf-life extension, recovery and reuse, sharing and service models, and digital platforms.[4] This requires increased collaboration across society, governments, companies and consumers alike to take stronger and innovative actions to promote sustainable growth.[5,6,7]

Effective policies can help accelerate and scale up circular actions in the economy. These policies support businesses in overcoming hurdles by stimulating innovative projects and long-term investments in circularity, facilitating collaboration and partnerships, and producing tangible results. Learning from these policies can help inform future policies to promote wider actions in other sectors and regions over time.

To better understand how policies can help unlock wider circular actions, this publication:

- **Highlights some representative pioneers in circular economy policy;**
- **Explores the key enablers from these policies that are essential to unlocking circular economy measures and potential;**
- **Describes how other regions could replicate these enablers; and**
- **Provides recommendations on how policymakers and businesses can leverage these enablers.**

This publication aims to provide insights from the policy perspective and to feed into the ongoing development of other initiatives and policies related to the circular economy globally.



2 An introduction to the policies evaluated

2 An introduction to the policies evaluated

Effective policies can introduce circularity by setting up reverse logistics and inspiring innovative business models. Changes in product design, in supply chains, and the production process as a whole can also motivate new circular business models and kickstart new initiatives by stakeholders.

Based on various policy effectiveness literature (see APPENDIX: APPROACH) and an in-depth review of over 100 policies from more than 12 countries,[8,9] we selected three recent policies that have shown positive impacts in different regions to analyze further:

1. The European Commission Circular Economy Package (EC CE Package);[10]

2. The Green Deals of the Netherlands;[11]

3. The China value-added tax (VAT) policy on the comprehensive use of resources.[12]

While these are just three of the many circular economy policies implemented in recent years,[13] they have shown progress in triggering circular actions in the economy.

1.1 EUROPEAN COMMISSION CIRCULAR ECONOMY (EC CE) PACKAGE

Strategically taken as an overarching framework, the EC CE Package has led to the successful mainstreaming of the circular economy into the European Union (EU) policy agenda. First introduced in 2014,[14] the package fits into the Europe 2020 Strategy for smart, sustainable and inclusive growth, and later introduces four legislative proposals on EU waste policy[15] and the adoption of the EU Circular Economy Action Plan in 2015.[16] The EC CE Package sets new waste management targets for 2030, including increasing the share of municipal waste prepared for reuse and recycling to 65% and the share of packaging waste prepared for reuse and recycling to 75%.[17] The recycling of municipal waste increased between 2008 and 2016 and the contribution of recycled materials to overall demand has continued to improve.[18] Since then, the package has re-examined the 54 circular actions of the 2015 Action Plan and combined several circular economy initiatives under one umbrella, including the EU Strategy for Plastics, communication to develop chemical and waste legislation, a monitoring framework, and the Report on Critical Raw Materials and the Circular Economy.[19]

Mainstreaming circularity has also inspired Member States to develop their own circular economy agenda, such as in Hungary, Luxembourg, Slovenia and Spain. In fact, having an overarching policy for the EU inspires Member States, which have not been too active on the circular economy,[20] to start rolling out national strategies and roadmaps, including Greece, Portugal and Romania.

The package also provides access to funds at the project level.
For example, drawing from parallel progress on the Horizon 2020 program, the EC CE Package identifies 247 completed projects related to the circular economy and in support of industry circularity, resource efficiency and the support of small and medium-sized enterprises (SMEs). Altogether, the 257 circular economy projects mobilized a total of EUR 1.45 billion to fund the EC CE Package.[21]

1.2 THE GREEN DEALS

The highly collaborative Green Deals initiative of the Netherlands initiative addresses non-financial circular economy barriers. It has put governments in direct communication with and depends on the support of the community, interest groups and companies. Green Deals support innovation domestically by providing the space to pilot test circular ideas with help from the government in pinpointing solutions to regulatory and administrative hurdles. It aligns with the Netherlands circular economy vision for 2050. More recently, there is a strong push to harness an international network.[22] Since the initiative's inception in 2011, the government has initiated 229 Green Deals; through 2018, it has successfully completed 169 across nine different aspects of the circular economy, including energy, the bio-based economy, mobility, water, food, biodiversity, resources, construction and the climate.[23] A recent Netherlands Environmental Agency policy review report found that the approach has added value to innovation with respect to multi-party agreements and cooperative sharing to achieve a circular economy. However, as a policy in-progress, the government could do more in terms of scaling-up and developing more ambitious targets.[24]

1.3 CHINA VAT POLICY ON THE COMPREHENSIVE USE OF RESOURCES

China has expanded its promotion of the circular economy by specific and quantifiable means. The country has implemented tax incentives that promote the circular economy by easing financial burdens on enterprises that recycle resources during production. Started back in 2009, the Chinese government has introduced various forms of value-added tax (VAT) incentives for the circular use of materials, such as agricultural, industrial and domestic waste.[25] The 2015 "Notice of the Ministry of Finance and the State Administration of Taxation on Issuing the Catalogue of Value-Added Tax Preferences for Products and Labour Services Involving the Comprehensive Use of Resources" is the latest version of such a policy, providing a comprehensive list of commodities and products that support reuse and recycle regimes for industries. The government introduced value-added tax refunds of 50% to 100% for specialized products such as recycled tires, sand produced from construction waste, cardboard and fiberboard.[26]

From these policy examples, we have identified four key enablers that are essential to unlocking circular economy measures and potential. With better understanding, it will be possible to replicate these enablers in future circular economy policies across regions with the support and actions of policymakers and businesses.

3 Key enablers

3 Key enablers

While the outcomes of these policies build upon various features, we specifically focus here on the enablers within these policies that help unlock and accelerate circular actions. After in-depth review of the three policies (see Appendix), we have identified four key enablers:

INCENTIVE MECHANISMS

PARTNERSHIPS & COLLABORATION

ALIGNING CIRCULAR ECONOMY IN MAINSTREAM POLICIES

TRACEABLE ACTIONS & TARGETS

By identifying these key enablers, policymakers and businesses can better understand how and why these enablers are effective in expanding circular economy implementation and how they can replicate them in other regions to promote wider and systemic changes to achieve a circular economy.[27,28,29]

2.1 INCENTIVE MECHANISMS

Different incentives can encourage stakeholders to adjust their current ways of thinking and acting, moving to a more circular approach. Such incentives should not only focus on financial support but also on non-financial measures that unleash market opportunities for circular products, services and business models (such as green public procurement). They can also aim to support the development of innovative technologies to support circularity, such as in electric vehicles, renewable energy, energy storage, 3D-printing, etc. Incentive mechanisms aim to create a level playing field for circular measures by accounting for environmental externalities. For example, the German city of Bremen has imbedded car-sharing in the management of its own fleet and uses carbon emission limits in the form of a certificate scheme to support procurement. Because of these efforts, the city has successfully procured better fleet management to reduce congestion on roads and parking lots. This has also had positive effects on transport emissions and car production.[30]

2.1.1 How does this enabler make these policies effective?

All three policy packages offer incentives to stimulate circular actions in the economy. For example, through the establishment of the Expert Group on Circular Economy Financing, the EC CE Package brings together experts from financial institutions, the business community, government, innovators and civil society in order to generate attention and investment opportunities for the circular economy.[31]

The Green Deals, in helping stakeholders overcome regulatory barriers and in providing non-financial support, encourage investment by easing regulatory constraints on products and encouraging green public procurement. See a detailed example from the China VAT policy in box 1.

Box 1. China VAT policy creates tax incentives for multiple sectors

Building upon previous policies on refunds for circular materials, the 2015 China VAT policy has created incentives for other companies to change business practices in their supply chains and innovate ways they can produce tax-exempt products. The law stipulates tax refund opportunities for products containing recycled content, such as:[32]

- 50% refunds for paper products with minimum of 70% recycled content and for tires with at least 95% recycled content;
- 70% refunds for cement with 20% to 40% recycled content[33]
- 100% refunds on power generation using at least 80% food waste, agricultural waste and other bio-based waste.

This has led to, for example, behavioral changes in the comprehensive use of waste tires in the Chinese automotive industry. Since 2006, the use of regenerated rubber in tires has more than doubled and more than 1,000 enterprises participate.[34]

These incentives coincide with broader developments in China to improve waste product reuse and recycling. For example, the country has certified 50 industrial parks dedicated to the circular economy of supply chains and has avoided an estimated 14 million tonnes in GHG emissions in 2016 by recycling plastics.[35] Supporting this aim in 2018, China banned imports of most waste types to further incentivize domestic improvements in recycling material waste.[36]

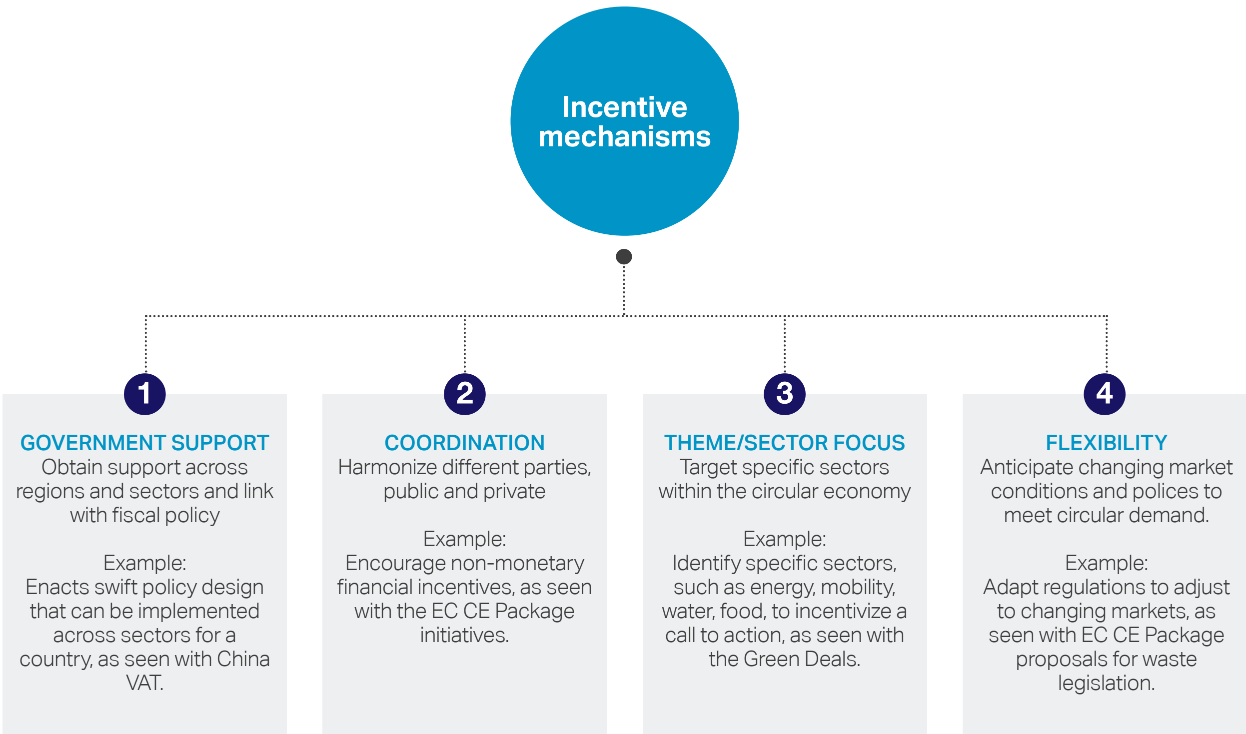
2.1.2 Why is this enabler important in helping accelerate the circular economy?

Both financial and non-financial incentives help businesses overcome initial upfront costs that typically deter transformational change and prevent circular products from reaching market maturity. For example, Green Deal 159, first struck in 2013, secures the conditions for green public procurement. It encourages high-quality reuse by establishing agreements among more than 50 stakeholders at the start of the purchasing process.[37] By drawing on the support of financial institutions and collaboration with financial experts, more access to funding creates better incentives, forming a solid symbiotic relationship. Another example includes the public-private partnership (PPP) between Georgia Regents Medical Center (GRMC) in the United States and Phillips Healthcare through a 15-year contract implementing circular initiatives using performance-based business models.[38]

2.1.3 How can other regions or areas replicate it?

When considering applying this to other regions, there are four good elements to incorporate incentive mechanisms into circular economy policies: government support, coordination, theme/sector focus and flexibility (see Figure 1). While many regions use incentives as a policy instrument, applying them in the circular economy context could be new to stakeholders. In areas where the topic has not gained much traction in the policy arena, taking small steps to experiment with this enabler would be essential, testing out different forms of incentives (flexibility), different focus topics or sectors, and with different stakeholders.

Figure 1: Incentive mechanisms: elements to replicate in other regions



2.2 PARTNERSHIPS & COLLABORATION

Partnerships and collaboration refer to forging mutual agreements among different parties from the private and public sectors. This can include international arrangements between governments on trade regulations or private suppliers and a single ministry within a country. It can include PPPs and coordinated or joint efforts among several government ministries. Collaborative efforts such as these enhance knowledge sharing and eventually the experience needed to create effective circular economy policies. Striving for collaboration helps form circular economy communities and create platforms for businesses to experiment with circular ideas. This encourages innovation by bringing various experts together as they share knowledge, unlock barriers and endeavor to reach a systematic path to circular change.

2.2.1 How does this enabler make these policies effective?

The Green Deals of the Netherlands and the EC CE Package effectively leverage partnerships and collaboration to facilitate cross-sector and stakeholder actions. Both harness the power of online platforms to engage stakeholders and show how learning through open communication and knowledge sharing can foster exchanges and lead to innovative solutions. The EC CE Package, for example, has created the European Circular Economy Stakeholder Platform, connecting with the Circular Economy Finance Platform and the Circular Economy Industry platform. Box 2 provides further details on the collaborative platforms under the Green Deals.

Box 2. Green Deals encourage innovation and cross-sector partnerships through pilot programs

The innovative Green Deals of the Netherlands provides a platform – a direct way – for the government to communicate and engage with stakeholders. The Green Deals online platform supports innovation by piloting new projects. Its visibility and clear communication have enabled partnership and collaboration among a wide range of parties. For example, in 2018, the Green Deals of the Netherlands initiated and signed the **Sustainable Healthcare for a Healthy Future Green Deal** as a public-private partnership comprising care providers, care professionals, patients, governments, and service and product suppliers. The goal of the partnership is to accelerate the sustainability of the healthcare sector. Initiators from different sectors have come together to reduce the sector's CO_2 emissions, reduce pharmaceutical residues in ground and surface water, create an environment that improves health, and promote circular operations, for instance by requiring circular criteria in healthcare procurement.[39] Other Green Deals encompassing multiple sectors include the **Green Deal on the Raw Materials of the Water Boards**, combining chemical and waste sectors in bioplastics and sewage sludge.[40]

2.2.2 Why is this enabler important in helping accelerate the circular economy?

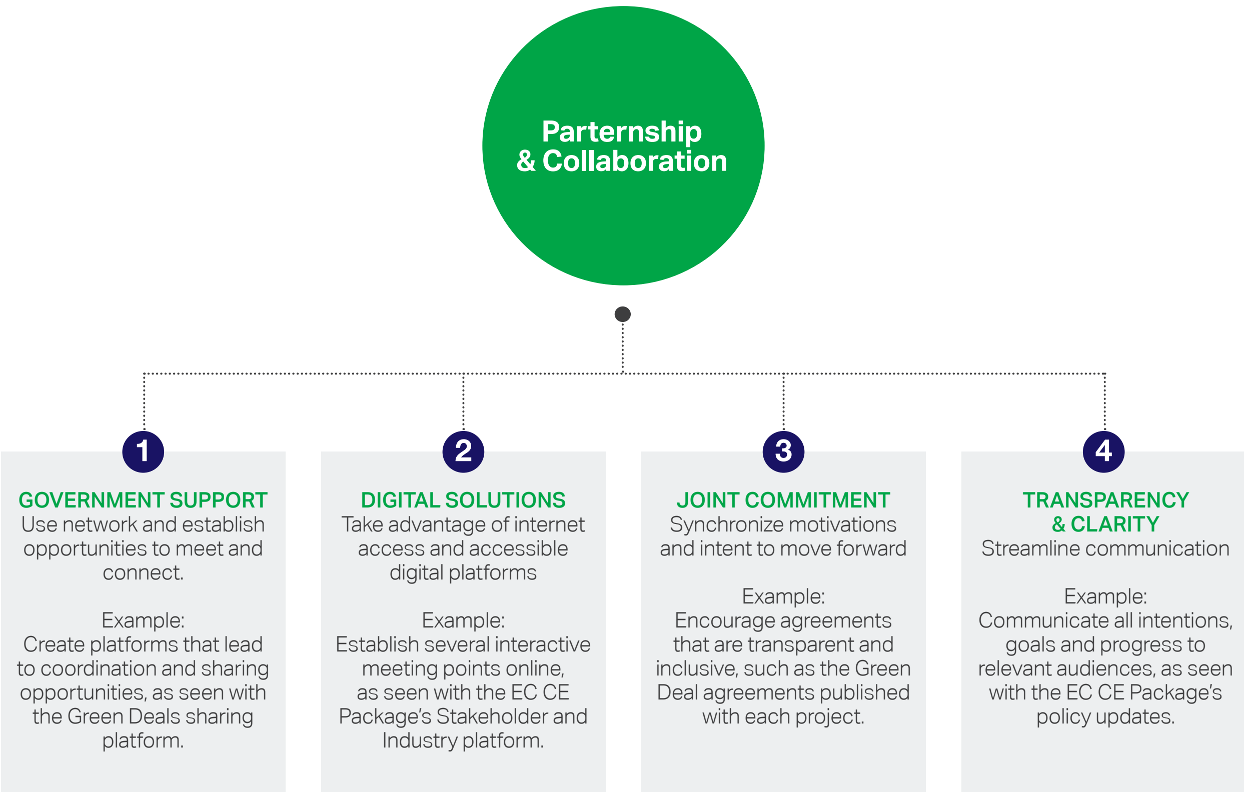
Partnerships and collaboration accelerate sharing among private and public stakeholders and across initiatives, and encourage cross-sector collaboration. They are an accessible, visible and interactive approach to the circular economy; as a result, they create a community that can break down existing linear, siloed systems by offering collaboration among stakeholders from sectors that do not normally work together.

For example, the Green Deal North Sea Resources Roundabout (NSRR) brings together industry and maritime trade sectors via policies initiated by the Netherlands, the UK, Flanders, France and the European Commission.[41] This enabler offers a testing ground for innovation in both technology and business models alike, scaling up circular actions in the economy.

2.2.3 How can other regions or areas replicate it?

There are four key elements to incorporate effective partnership and collaboration into the circular economy: government support, digital solutions, joint commitments and transparency and clarity (see Figure 2). Importantly, timing plays a crucial role in collaboration as it is only possible to establish it once organizations have targeted sectors and drawn up roadmaps. Then they can identify key stakeholders to forge deeper relations in order to better create and implement the strategy for circular economy policies. This process can be iterative in different implementation phases to review and strengthen policy impacts.

Figure 2: **Partnerships & collaboration: elements to replicate in other regions**



2.3 ALIGNING THE CIRCULAR ECONOMY IN MAINSTREAM POLICIES

It is possible to prioritize the circular economy and draw it out of the policy agenda by referencing existing policies to co-create momentum and promote positive impacts. Linking with mainstream economic, social and environmental policies is a powerful tool to draw support from additional networks, expertise and budgets. Ultimately, policymakers and society do not have to start from scratch when embedding the concept of circularity in existing policies.

2.3.1 How does this enabler make these policies effective?

Each of the three policy packages demonstrates alignment with existing policy initiatives. The Green Deals support and connect several parallel initiatives under the Nederland Circulair in 2050 (Netherlands Circular in 2050). This has allowed for two green deals – Green Deal 226 on Sustainable Healthcare and Green Deal 223 on Circular Procurement – to tap into an expansive central government network with administration commitments to remove any legal and regulatory burdens faced during implementation. Green Deal 223 allows members to gain practical experience with circular procurement while providing a space to share experiences.

The China VAT policy links with other environmental policies that blacklist high-impact and high-pollution sectors and defines compliance with existing environmental standards, such as effluent emissions, air pollution and recycling technology requirements. By connecting to existing environmental standards, it enhances environmental procurement and recycling in several sectors, including construction, transport and fabric production. Box 3 provides further examples of other policies the EC CE Package connects and leverages.

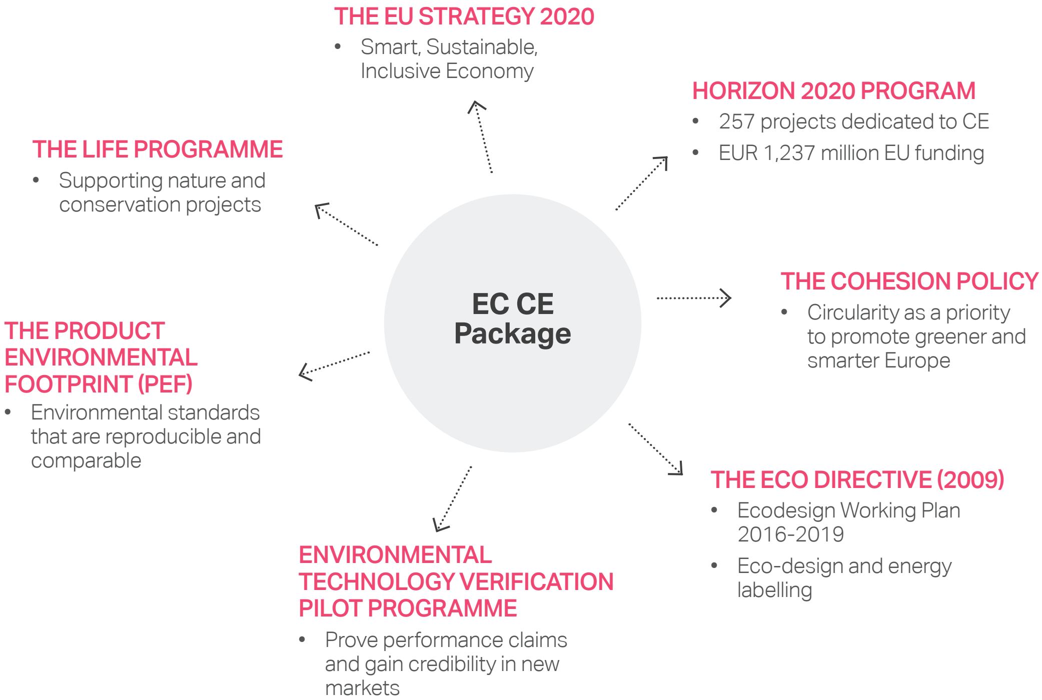
Box 3. EC CE Package draws from various EU initiatives to promote the circular economy programs

The EC CE Package has been able to connect a wide variety of initiatives from the past and for the future, as illustrated in Figure 3. The Europe 2020 Strategy aims to turn the EU into a smart, sustainable and inclusive economy delivering high levels of employment, worth EUR €8.3 million (or EUR €1.1 per inhabitant). The strategy's priorities include the promotion of more resource-efficient, greener and more competitive economic synergies with the EC CE Package. This is because the package has set particular mandates in line with circular economy principles, including circular design and production processes, empowering consumers, and waste management.[42,43]

Supporting circular design, for example, the Ecodesign Working Plan 2016-2019 and the Environmental Technology Verification pilot programme (ETV) contribute to the EC CE Package. The Ecodesign Working Plan has resulted in 28 ecodesign regulations, and 16 energy labelling delegated regulations in support of material efficiency requirements, such as availability of spare parts, ease of repair, and facilitating end-of-life treatment. The EU ETV pilot program validates manufacturing processes that are environmentally beneficial, thereby gaining technological added-value credibility. Similarly, in order to empower consumers, the Product Environmental Footprint (PEF) methodology supports circular economy initiatives. It allows for the identification of environmental hotspots through life-cycle environmental performance promotion to business partners and consumers. Additionally, the work of the Horizon 2020 program, the LIFE programme and the Cohesion Policy led to the accessing of funds totaling roughly EUR €10.7 billion.[44]

With the inclusion of institutions like the European Investment Bank (EIB), leveraging allows for greater reach into European policies with a broader focus, such as the Cohesion Policy, containing the general message of reducing disparities between various European regions. A key financial instrument is the European Fund for Strategic Investments (EFSI), which, in partnership with the EIB, aims to achieve circular economy objectives in line with the European 2020 strategy. This type of policy alignment has engendered new projects, pilot testing and support for industry and SMEs alike.

Figure 3: The EC CE Package aligns policies under the circular economy



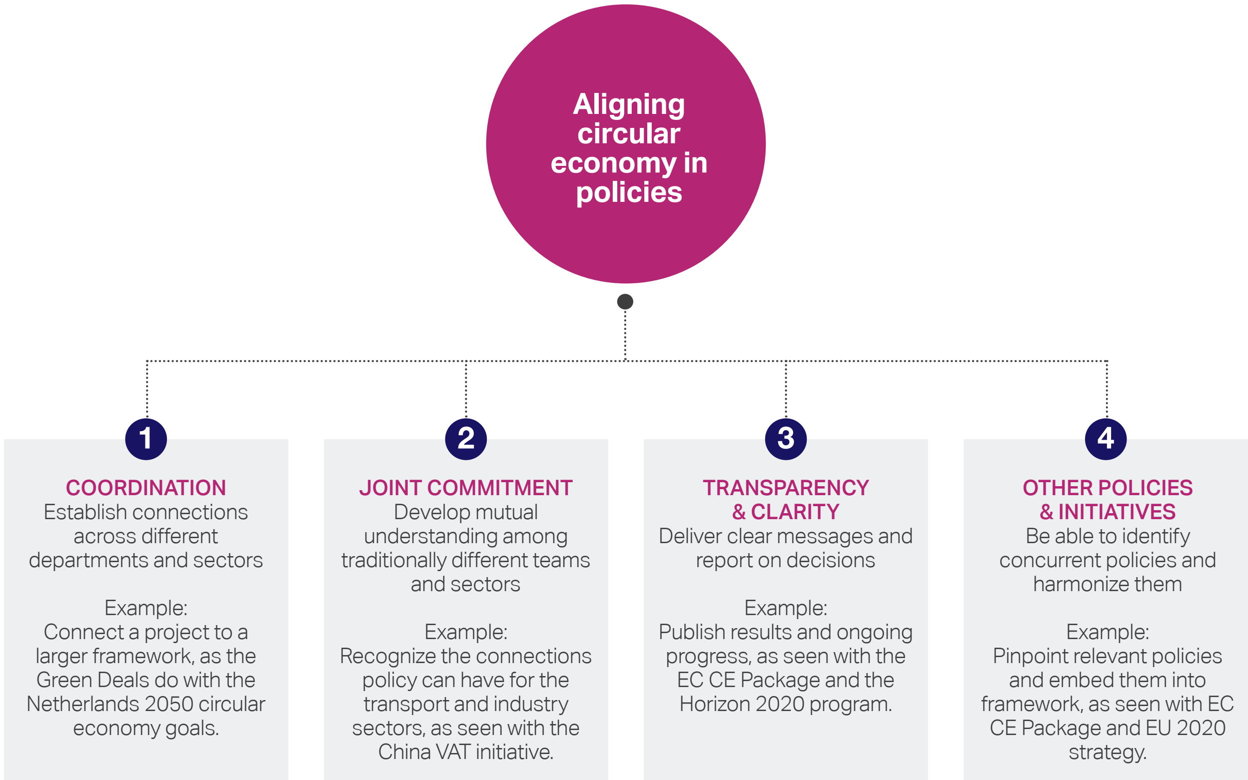
2.3.2 Why is this enabler important in helping accelerate the circular economy?

Integrating circularity into existing policies encourages stakeholders to piece together relevant aspects of the circular economy within their organizations. It streamlines the circular agenda by connecting the dots, activating actions and support from businesses and stakeholders alike. Building the connection between the circular economy and other mainstream policies also takes learnings from these policies into account and shapes it into a circular economy framework.

2.3.3 How can other regions or areas replicate it?

There are four key elements to incorporate this enabler into the circular economy: coordination, joint commitments, transparency and clarity, and harmonizing with existing policies (see Figure 4). A combination of cooperative and communicative elements should support these efforts when adopting this enabler in other regions. If mainstream policies or other initiatives do not necessarily have circular economy aspects to identify, it is important to view this as an opportunity to use coordination and commitment to embed circular economy objectives into new policies to achieve greater potential for future alignment.

Figure 4: **Aligning the circular economy in other policies: elements to replicate in other regions**



2.4 TRACEABLE ACTIONS & TARGETS

Effective circular economy policies must have traceable actions and targets. This leads to tangible results and holds stakeholders accountable for their progress. This enabler ensures the consistent monitoring of results, the capacity to reproduce them and their evolution over time.

2.4.1 How does this enabler make these policies effective?

To trigger concrete actions, it is necessary to set timelines and targets in various sectors in order to produce tangible results. Quantifiable targets can help specify and benchmark progress. The Green Deals, for example, support the Waste-to-Resources program (VANG Buitenhuis program) with specific targets for reducing the volume from residual waste by half, from 2 million tonnes to 1 million tonnes by 2022.[45] Box 4 provides further details on the actionable targets from the EC CE Package.

Box 4. EC CE Package sets specific targets in a quantifiable and transparent way

The EC CE Package provides a general vision and represents inclusive and actionable goals. This plan intends to meet specific targets in production, consumption, secondary raw materials and innovation,[46] with the goal of targeting waste as a resource and improving resource productivity. Resource productivity targets include a 30% increase by 2030, which would result in 0.8% increase in GDP while creating two million jobs.[47] Among the new waste management targets, for instance, by 2030 the share of municipal waste for reuse and recycling will increase to 70% from the current 27% average. The share of packaging waste prepared for reuse and recycling will increase to 80%, with specific targets for various materials, including plastic. Among the 54 specified actions[48] of the circular economy package, plastics are a priority, which has led to the European Strategy for Plastics and the goal to eliminate single-use plastics in 11 targeted categories.[49] The package also includes a monitoring framework complete with an online database,[50] which houses more than 20 specific Nomenclature of Economic Activities in the European Community (Nomenclature des Activités Économiques dans la Communauté Européenne – NACE) indicators for circular economy activities.[51]

2.4.2 Why is this enabler important to helping accelerate the circular economy?

Having consistent and robust data to assess the current status as a baseline is crucial to target setting and action. By monitoring specific targets, policymakers can hold parties responsible for their actions in a given timeframe, while long-term target planning provides stability for circular investment and business planning. Ongoing monitoring allows for review, reflection and adjustment to the changing market, resulting in more effective implementation.

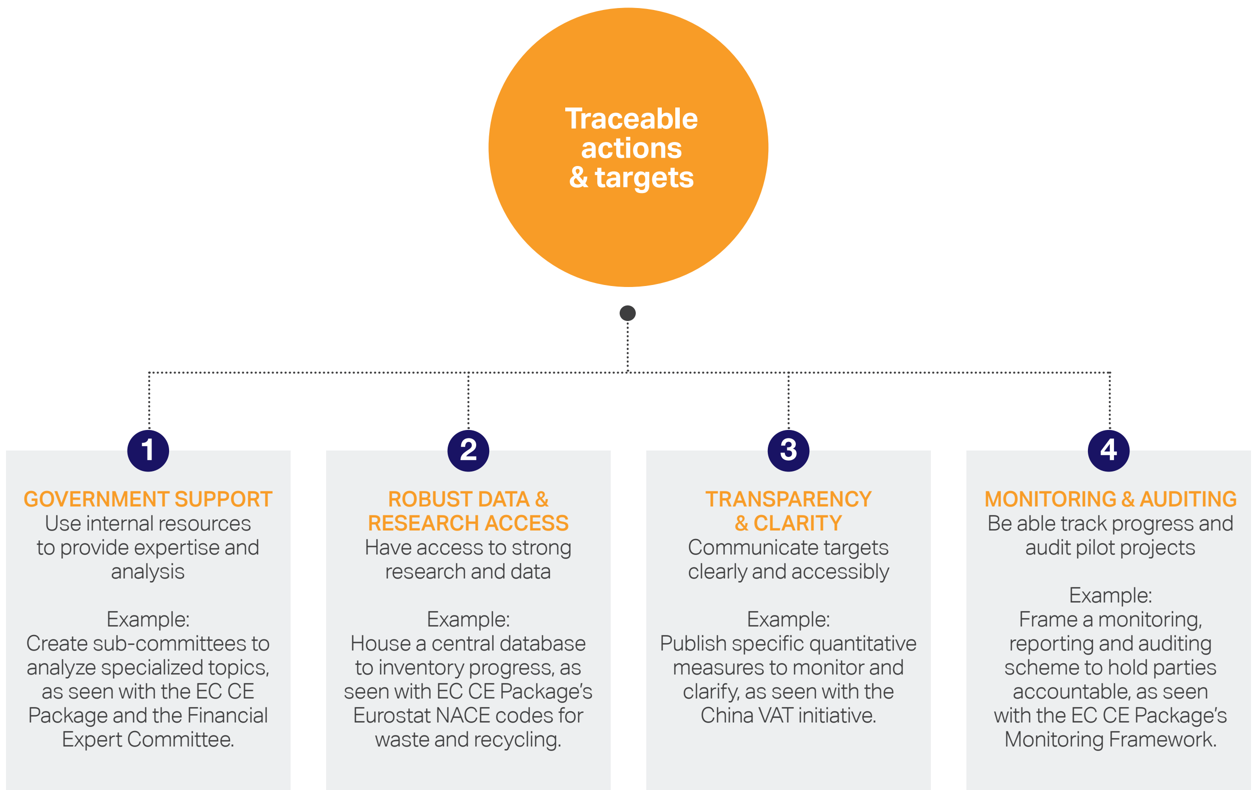
Finally, this enabler provides clear and tangible messages for actions and signals businesses and civil society can readily absorb.

2.4.3 How can other regions or areas replicate it?

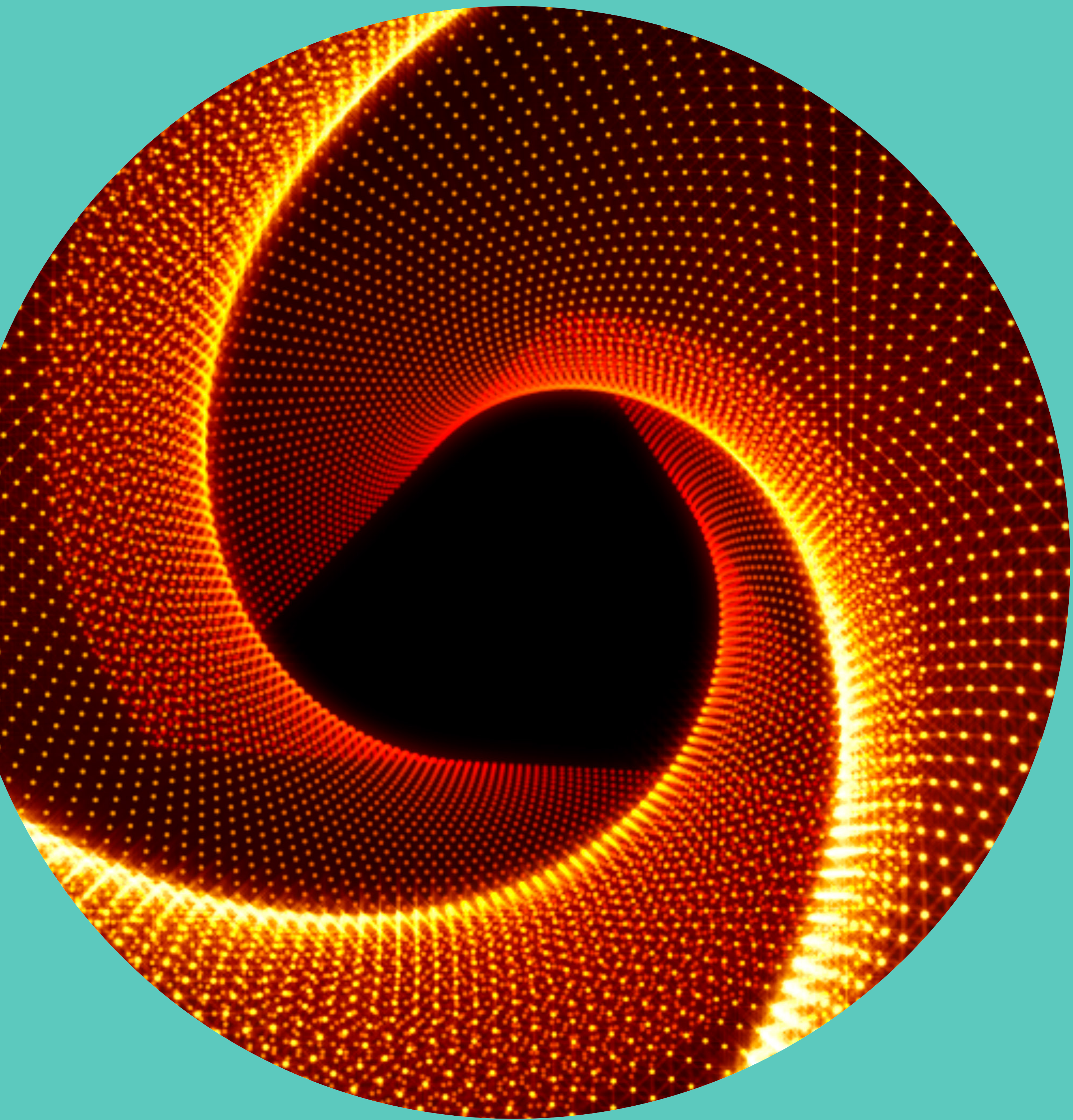
Figure 5 highlights four elements to replicate this enabler in other regions: government support, robust data and research access, transparency and clarity, and monitoring and auditing. Changes in behavior and business models take time, especially in regions where the circular economy is relatively new.

Therefore, certainty and positive signals from target setting and progress tracking are crucial. Government often plays a key role in supporting the relevant infrastructure, through its authority for target commitment, support in building processes and monitoring progress, and safeguarding the governance of this process. These efforts will help spark ideas and actions by stakeholders in new regions and produce tangible results for study and further improvement.

Figure 5: Traceable actions & targets: elements to replicate in other regions



4 Recommendations



4 Recommendations

Effective circular economy policies can stimulate changes in systems and business models while amplifying key enablers that unlock further potential for success.

While these enablers describe particularly good policies, they also address challenges in policy design, such as: a lack of financial resources, abstract targets and goals, and an unclear understanding of the results. Other challenges include a lack of strategy or the presence of circular economy policies in general. Regions where the circular economy is less prominent in policy agendas are particularly exposed to start-up challenges.

Some non-Organisation for Economic Co-operation and Development (OECD) countries, such as Colombia, Laos and Rwanda, have begun to roll out circular economy practices in recent years in waste sorting and reuse, but have yet to grasp the use of circular design to generate sustainable development opportunities.[52] Leveraging key enablers can help in further scaling these efforts to include other topics, sectors and regions.

Promoting the circular economy in other places around the world could allow for more efficient, flexible and systemic changes needed for circular and sustainable development through the key enablers. Actions from both policymakers and businesses are essential to ensuring these enablers gain traction, whether they involve leveraging resources or convening experts. For example:

Policymakers can...[53]

1. **Establish circular economy roundtables or working groups across governments or government departments.** Establish ongoing dialogues among relevant key parties to discuss, streamline and prioritize the integration of the circular economy in the wider policy agenda across developed and developing countries. For example, governments in Rwanda, Nigeria and South Africa have forged partnerships and collaboration with the EU and the World Economic Forum. Such discussions should align on clear targets and commitments through transparent communications, and share learnings and relevant expertise from circular policy implementation. They could build upon existing cross-party dialogues, such as the China-EU Memorandum of Understanding, EU-Indonesia Business Dialogue, EU-Mexico High Level Dialogue on Environment, OECD Regional Policy Dialogue meetings, and the United Nations Environment Assembly.

2. **Organize platforms and network for knowledge exchange and innovation.** Establishing centers for knowledge-sharing facilitates exchanges among traditionally unrelated sectors and promotes knowledge transfer from potential expert experience to nascent circular policy-building. The sharing of knowledge and coalitions formed will lead to new ideas and innovative solutions that connect stakeholders and accelerate effective strategy and implementation. The platforms exemplified through the Green Deals and the EC CE Package can also be a way to evaluate the effectiveness of incentives and stimulate feedback into future policy design. Other platforms include the recently launched African Alliance on Circular Economy, which exhibits the use of digital platforms. Other collaborative efforts using digital platforms in other parts of the world include Canada's Circular Economy Leadership Coalition and the U.S. Circular Economy Accelerator: A Recycling Partnership Initiative.

3. **Ensure flexible and responsive policy design and policymaking.** To recognize the evolving needs of business to overcome the initial hurdles, such as simplifying regulations and unlocking barriers (for example, defining "end of waste" and the use of secondary raw materials), governments can implement circular economy policies in gradual phases, with ongoing dialogue and engagement with businesses in parallel. They can also create near-term roadmaps with milestones and mechanisms to revise and enhance existing policies. Finland's Circular Economy Roadmap is an example of continuous policy-making tracking and refining.[53]

4. **Measure the outcomes and effectiveness of circular economy policies.** Organizations often assess

the impacts and potential of the circular economy in economic and environmental terms, especially within the EU. Such impact assessment should be applied to circular policies by adding a social dimension using frameworks such as the Sustainable Development Goals. The qualitative and quantitative, if possible, evidence of the social, economic and environmental benefits of circular policies not only helps inform future policy design, it also helps motivate wider adoption and efforts across sectors and regions.

Businesses can...

1. **Form partnerships and participate in pilot projects with policymakers and other stakeholders to explore ways to unlock circular economy potential**. This encourages committee formation and aligns separate business units internally and within the supply chain to achieve circular economy design. It also activates the conversation between government and businesses to target the areas that need action the most. In addition to public-private partnerships such as the Green Deals, some business-led initiatives have been active across regions – Factor10, the Circular Economy Accelerator in the U.S., the Circular Economy Leadership Coalition in Canada, the Ellen MacArthur Foundation, the Circular Economy Club, etc. Major companies have been taking part in some of these initiatives and providing case studies for others to adopt and communicate with respective stakeholders for further actions.

2. **Proactively explore new means to implement and finance circular economy solutions.** Independently identifying solutions particular to an industry or business can help policymakers understand where streamlining support should occur on the policy side. Then, businesses can actively give feedback to governments about discoveries, align targets and engage with financial institutions about the potential prospects of such solutions to increase access to capital. For example, DSM has invented a circular manufacturing approach to making carpets 100% recyclable and 90% less energy-intensive.[55] In order to overcome regulatory hurdles, DSM has supported Zero Waste Europe's call-to-action mandating circular regulations to adopt this innovative design and connecting private industry with policymakers.[56]

3. **Establish company-wide commitment to the circular economy internally and externally.** A clear dedication to circular actions not only helps policymakers recognize the needs and willingness of businesses to scale up the circular economy; it also helps provide a strong signal to company staff. Clear commitment could also spread across the whole value chain, unlocking further potential business opportunities for businesses. For example, more than 30 companies have committed to the Alliance to End Plastic Waste; This commitment gives strong signals to internal stakeholders to support mitigation measures and a means to engage with suppliers to work jointly on this goal.

5 Appendix: approach

IDENTIFYING POLICY EXAMPLES FOR KEY ENABLER ASSESSMENT

We used the 2018 Circular Policy Action Brief as the starting point in identifying the three representative policies highlighted in this report.[57] The brief includes over 100 circular economy policies from more than 12 regions, including China and the EU, assessed under 12 parameters covering circular business models, policy frameworks and sector types. Based on the literature review, we have summarized the key characteristics and used them to review policies from different regions (see Figure 6 below).[58,59,60,61,62,63] These sources[58-63] collectively look into different aspects, such as the need to scale up, common policy barriers, actions needed from the public and private sectors, the policy agenda and a future vision.

Our goal was to highlight policies that can help businesses overcome the initial hurdles to scale up circular actions. From this perspective, we found that all of these circular elements are related to certain overarching themes that could better aid business solutions. Better policies could introduce circularity by setting up reverse logistics and inspiring innovative business models. Changes in:

- product design
- supply chains
- production process

can also motivate new circular business models and kickstart new initiatives in the economy. On:

- resource and material efficiency
- waste collection
- material recycling
- refurbishment of manufacturing

clear targets can aid, prioritize and encourage strong action and implementation.

Figure 6: Identifying three policy examples with potential to accelerate the transition to the CE in different regions

Contribute to key circular economy solutions

- Set up networks for reusing, recycling, efficiency and design
- Effect change in business models in the process
- Streamline pure material flows

Unlock barriers

- Provide supportive structure and incentives for circularity
- Simplify compliance/ implementation approaches

Inclusive and actionable

- Set specific targets that are tangible and quantifiable
- Engage stakeholders on multiple levels, public and private

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Maison de la Paix
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World Health Organization

REGIONAL OFFICE FOR Europe

CIRCULAR ECONOMY AND HEALTH:

OPPORTUNITIES AND RISKS

ABSTRACT

The extensive use of natural resources threatens to exceed the carrying capacity of the Earth. The concept of a circular economy offers an avenue to sustainable growth, good health and decent jobs, while saving the environment and its natural resources. Further, the change from a linear economy (take, make, dispose) to a circular economy (renew, remake, share) is expected to support significantly the attainment of the Sustainable Development Goals (SDGs), particularly SDG 12 on responsible consumption and production. So far, however, the coverage of the health implications of a transition to a circular economy has been relatively limited. This report therefore aims to start to address this deficiency by framing the transition in a health context, to set the scene for further policy development, the assessment of research needs and stakeholder engagement in key health implications. It shows that the transition to a circular economy provides a major opportunity to yield substantial health benefits, such as direct benefits to health care systems and indirect benefits from reducing negative environmental impacts. There are also risks of adverse and unintended health effects, however, in processes involving hazardous materials, for example; circular economy strategies and particularly national, regional and local implementation plans need to be identify and address these risks.

KEYWORDS
CONSERVATION OF NATURAL RESOURCES
ENVIRONMENTAL HEALTH
ECONOMICS - TRENDS
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Alistair Hunt, University of Bath, United Kingdom
Nick Dale, independent researcher, United Kingdom
Frank George, Technical Officer, Environmental Health and Economics, WHO Regional Office for Europe

ABBREVIATIONS

ACES	Alliance for Circular Economy Solutions
AMR	antimicrobial resistance
BFRs	brominated flame retardants
BPA	bisphenol A
CFCs	chlorofluorocarbons
CHEM Trust	Chemicals Health and Environment Monitoring Trust
CLP Regulation	(EU) classification, labelling and packaging Regulation
CO_2	carbon dioxide
CSOs	civil-society organizations
DAKOFA	Waste and Resource Network Denmark
DALYs	disability-adjusted life-years
DEHP	diethylhexyl phthalate
DPSEEA framework	Driver, Pressure, State, Exposure, Effect, and Action framework
e-waste	electrical and electronic waste
EC	European Commission
ECHA	European Chemicals Agency
EHP	European Environment and Health Process
EIB	European Investment Bank
EMF	Ellen MacArthur Foundation
EU	European Union
EU27	the 27 countries belonging to the EU before July 2013
G7	Group of 7
GDP	gross domestic product
GHG	greenhouse gas
HEAL	Health and Environment Alliance
ISO	International Organization for Standardization
LIFE+	EU Financial Instrument for the Environment
MRI	magnetic resonance imaging
NGOs	nongovernmental organizations
PCBs	polychlorinated biphenyls
PFCs	perfluorinated chemicals
PVC	polyvinyl chloride
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (EU)
REBMs	resource-efficient business models
ReSOLVE framework	Regenerate, Share, Optimise, Loop, Virtualise, and Exchange
RoHS Directive	Restriction of Hazardous Substances Directive
SDGs	Sustainable Development Goals
Sitra	Finnish Innovation Fund
SSPs	sanitation safety plans
STEP Initiative	Solving the E-Waste Problem Initiative
SVHCs	substance of very high concern
UNIDO	United Nations Industrial Development Organization
VAT	value-added tax
WEEE Directive	Waste Electrical and Electronic Equipment Directive
WRAP	Waste and Resources Action Programme

KEY MESSAGES

The extensive use of natural resources threatens to exceed the carrying capacity of the planet. The concept of the circular economy offers an avenue to sustainable growth, good health and decent jobs, while saving the environment and its natural resources. This concept has gained increasing prominence in recent years in policy development at the international, European Union and national levels of governance, and in business practices and consumer behaviour. Until now, the focus has been on the benefits of a transition to a circular economy from the point of view of efficient and sustainable production and consumption. Coverage of the health implications has been relatively limited.

This report aims to start to address this gap by framing the concept of the circular economy and its implementation in the context of health, to set the scene for further policy development, research and stakeholder engagement.

A transition to circular economy provides a major opportunity to yield potentially substantial health benefits while contributing to the attainment of a number of Sustainable Development Goals. The benefits are both direct, such as savings in the health care sector, and indirect, from reduced environmental impacts of production and consumption.

There are also risks of unintended adverse health effects in this transition, particularly related to managing risks from exposures to hazardous materials. Where such risks have been identified, they frequently affect vulnerable groups disproportionately, through, for example, informal work practices involving children and low-income groups.

The understanding of the health impacts of a transition to a circular economy – particularly in relation to chemicals of concern, water reuse, electrical and electronic waste, and distributional effects – shows significant gaps. Further research and evidence are essential to enable a more complete assessment of policy priorities for addressing the negative impacts and enhancing the positive ones.

Both policy discussions and national, regional and global strategies and action plans for a circular economy need to increase their coverage of and better integrate health benefits and risks. The health sector should therefore be actively involved in the transition process.

Policy priorities that have been identified for addressing areas of immediate concern include: appropriate regulation, monitoring and evaluation of circular economy initiatives; support for research; improved management of informal waste sites; and measures to raise public awareness. These should be addressed so that no reductions in support from the public and the policy community undermine progress in implementing the circular economy, including realizing potential health benefits.

All key stakeholders have important roles in securing health benefits and minimizing health risks, including intergovernmental organizations, governments of WHO Member States, the public sector, the business sector, nongovernmental and civil-society organizations, the research community, the mass media and the general public. Dialogue and cooperation between stakeholders, through agreed partnerships and action plans, are vital to drive progress in promoting the health benefits and addressing the health risks of the transition to the circular economy.

EXECUTIVE SUMMARY

This report explores the policy objective of a circular economy and its implications for human health. While the concept of the circular economy has recently gained increasing prominence in policy development at the national, European Union (EU) and global levels, and in business practices for the promotion of sustainable production and consumption, coverage of its health implications has been relatively limited. This report aims to start to address this gap by framing the concept of the circular economy and its implementation in the context of health, outlining the current evidence on health implications and setting the scene for further policy development, the assessment of research needs and stakeholder engagement.

Definitions of a circular economy have two main types: those that are resource oriented and focus on the need for closed loops of material flows and reduced consumption of virgin resources, and those that go beyond the management of material resources to incorporate additional dimensions, such as changing models of consumption. Implementation is therefore characterized by: reducing the use of primary resources, maintaining the highest value of materials and products, and changing utilization patterns. In practice, the actions needed to achieve this transition include: recycling; efficient use of resources; utilization of renewable energy sources; remanufacturing, refurbishment and reuse of products and components; the extension of product life; treating products as services; sharing of products; prevention of waste, including designing out waste in products; and a shift in consumption patterns. Alongside these actions, the phasing down of incineration and landfill as options for waste management is seen as a necessary requirement. To enable the actions and range of investments needed for such a transition, changes in perception and behaviour are needed at all levels, from consumers to producers and policy-makers.

A number of **global and European initiatives** are associated with the circular economy concept. In particular, circular economy principles have been identified as a means to address several of the Sustainable Development Goals (SDGs) (United Nations, 2018), notably SDG 12: "reduc[ing] waste generation through prevention, reduction, recycling and reuse (12.5), and "achiev[ing] the sustainable management and efficient use of natural resources". The circular economy concept is also strongly interlinked with and incorporated in the green economy concept, particularly in relation to its low-carbon and resource efficiency focus.

The **current state of play** in the implementation of the principles of the circular economy encompasses a great range of activities across the WHO European Region, although engagement with the concept is much greater in EU countries than non-EU countries. A key development in the EU is the adoption of the EU action plan for the circular economy (EC, 2015b), which sets out a timeline for action on production, consumption, waste management, the market for secondary raw materials, sectoral actions and innovation, with targets for the reduction of waste and a long-term path for waste management and recycling. These aim to continue recent trends towards a decline in waste generation per capita in the EU and an increase in recycled and composted municipal waste, along with decreases in landfilled waste. Business is seen to have a crucial role in progress towards the circular economy, particularly through developing innovative circular approaches to production and consumption. Waste management companies in Europe have widely adopted circular economy practices, and a variety of networks of businesses and nongovernmental organizations (NGOs) have been established to promote the gathering and sharing of knowledge and experience. Few of these, however, deal directly with health-related issues.

This report develops a **framework to categorize pathways** through which the implementation of circular economy models may affect human health and well-being. Based on a literature review and expert consultation, it identifies real and potential positive and negative health implications of circular economy processes, along with the economic sectors affected and issues related to distribution, focusing especially on impacts on vulnerable groups. To the extent possible, the framework draws on and adapts useful existing frameworks and classifications from the literature on environment and health, including from WHO initiatives.

General findings on the implications for human health from the implementation of circular economy models are as follows.

- Reducing the use of primary resources, maintaining the highest value of materials and products (through the recycling and reuse of products, components and materials) and moving towards greater use of renewable energy and energy efficiency have many **positive health implications**. In particular, direct and indirect benefits come from reducing the environmental impacts of manufacturing processes (and making cost savings in households and in the health sector).

- There is also potential for significant health benefits from changing utilization patterns, for example, through the health system introducing performance models in the procurement of equipment, and a wide range of health benefits, due to a reduction in environmental impacts, from shifts to product sharing and product-as-a-service models. The potential **negative health impacts** identified relate to risks in the recycling and reuse of products, components and materials. This refers in particular to the management of chemicals of concern, such as bisphenol A (BPA) and brominated flame retardants (BFRs) in a variety of products, and to emissions from the composting of waste. The report contains a number of case studies on these issues, including for chemicals of concern, electrical and electronic waste (e-waste), and food safety.

- Where negative impacts have been identified, their effects frequently fall disproportionately on **vulnerable groups** in Europe and globally. A key concern is the export of waste, such as e-waste, to dumping sites in developing countries, where the local population engaging in informal recycling is often more deprived than the general population. Conversely, the reduced global environmental pollution resulting from the circular economy will result in long-term health gains that may benefit disadvantaged groups, which are known to be disproportionately affected by environmental impacts. More detailed distributional assessment, however, is needed for each health impact identified.

- Research is underway that addresses the potential health impacts from a transition to circular economy; it considers, for example, chemicals of concern, water reuse and e-waste. Significant **knowledge gaps** exist, however, particularly those related to the nature of negative impacts (e.g. in the case of hazardous chemicals); the quantitative analysis of exposures and endpoints related to the identified potential health impacts could help build understanding of their relative significance. A small number of aggregate estimates of the potential benefits from specific circular economy policies are available, some of which suggest very significant potential benefits across a number of sectors and for the general population (e.g. EMF, 2015b; Ex'Tax et al., 2016). At best, these are order-of-magnitude estimates, however, and more detailed quantitative analyses for specific benefits and identified health impacts are needed. Thus, further research and evidence are essential for a more complete assessment of priorities for addressing negative impacts and enhancing positive impacts, in order to inform policy development.

A key **general conclusion** from this study is therefore that the transition to a circular economy could provide a major opportunity to yield substantial health benefits that will contribute to achieving the SDGs. Nevertheless, the transition also carries risks of adverse unintended health effects, for example, in processes related to hazardous materials; circular economy strategies and implementation plans need to identify and address these.

In view of these findings, and the relatively limited coverage of health issues in the transition to a circular economy, it is clearly necessary to increase the coverage of and better place health in national, regional and global policy discussions and future strategies, frameworks and action plans for a circular economy. To this end, the health sector and public health agencies such as WHO should be key stakeholders in supporting the transition process. In particular, they should actively support countries to define their strategies and translate them into national, regional and local action plans.

Further work is needed to identify and elaborate **priority actions** to maximize health benefits and minimize risks in the short and medium terms. Policy priorities identified in this report for addressing areas of immediate concern include:

1. further development of regulation for a number of direct negative health impacts;
2. better information flows on component materials in products to aid prevention and safe removal of harmful substances in recycled materials;
3. support for research where significant gaps exist, especially quantitative analysis of exposures, and endpoints related to identified potential health impacts, including distributional effects; and
4. actions to address health impacts of informal waste sites, including reducing risk of exposures to hazardous materials.

Urgent action to address these areas of concern is needed to ensure that no reductions in support from the public and the policy community resulting from these concerns undermine progress in implementing the circular economy and its potential for significant medium- and long-term health benefits.

Other identified policy priorities include the development of indicators for monitoring progress in realizing the health benefits and reducing the health risks of circular economy programmes, as well as promoting public awareness of the benefits of the circular economy, including those to health, and policy development on distributional issues informed by current research.

The conclusions (given in section 9) emphasize the important **role of key stakeholders**, including the policy and research communities, in achieving health benefits and addressing health risks. Business plays a crucial role in developing and implementing circular processes that can be the source of key direct and indirect benefits for both public and occupational health (e.g. by reducing air and water pollutant and GHG emissions in extraction, manufacturing and consumption processes). Business and NGOs also have a key role in addressing the potential unintended risks to public and occupational health of circular economy actions, including through the development of substitutes for hazardous materials.

In addition, civil society can become more engaged in the circular economy and thus contribute to healthy outcomes – for example, through contributions to lower production and consumption emissions – in a number of ways. These opportunities include promoting behavioural changes such as involvement in sharing platforms (e.g. car sharing) and consumer choices (e.g. recycling products and reused components).

Finally, while the report includes a number of key conclusions for key stakeholders, multistakeholder **partnerships and collaboration** between WHO Member States, NGOs, intergovernmental organizations, the private sector and academe, through agreed partnerships and action plans, are vital to drive progress in achieving the health benefits and addressing the health risks of the transition to a circular economy.

1

Overall aims of this analysis report

The WHO Regional Office for Europe commissioned this study as a background paper for its expert meeting, "circular economy Meets Environment and Health – Opportunities and Risks", held in Bonn, Germany in October 2017. The study's rationale was that, while the circular economy concept has gained increasing prominence in recent years, in the context of policy development and business practices for the promotion of sustainable production and consumption, coverage of its health implications has been relatively limited. The transition to a circular economy can have potentially significant health benefits through, for example, contributions to climate change mitigation and better air quality. If this transition does not adequately take account of the health implications, it also carries the risk of adverse health effects from, for example, processes related to hazardous materials.

This study therefore aimed to start to address this deficiency by framing the transition to a circular economy in a health context, and to set the scene for the further development of policy, assessment of research needs and engagement of stakeholders including business, NGOs and civil society in this important subject. The target groups are therefore the communities engaged in health, environmental and economic policy and research; the business sector; civil-society organizations; and the mass media. It should also be of interest to a more general readership.

As to the structure of this report, section 2 briefly explains definitions of the circular economy, related concepts, models of implementation and links to existing WHO programmes. Section 3 reviews the implementation of the circular economy concept, particularly countries in the WHO European Region. Section 4 provides an overview of the links between the transition to a circular economy in the broader macroeconomic and social context, and its implications for human health, including a discussion of distributional effects. Section 5 suggests a framework for reviewing, identifying and analysing the range of potential health impacts resulting from the transition to a circular economy. Section 6 uses this framework to outline the potential positive and negative health effects of moving towards a circular economy, including both direct and indirect effects, the stakeholders affected and distributional issues. It also presents and discusses the available quantitative evidence for these effects. Section 7 discusses a range of case studies on health issues related to the circular economy transition. These include a discussion of the health care sector, chemicals of concern, e-waste, food safety and waste-water reuse, along with broader outlines for the built environment, climate change and air pollution. Section 8 summarizes policy options for promoting the circular economy and addressing possible negative health risks. Finally, section 9 gives general conclusions on the positive and negative implications of the circular economy model for health, as well as specific conclusions on policy, research needs, business and NGOs. It also proposes ways to increase and better place health in the policy discussions and future national, regional and global strategies, frameworks and action plans for a circular economy.

The research for this report included a desk-based review of the relevant international literature, as well as consultations with experts on the circular economy and its implications for health and the environment.

2

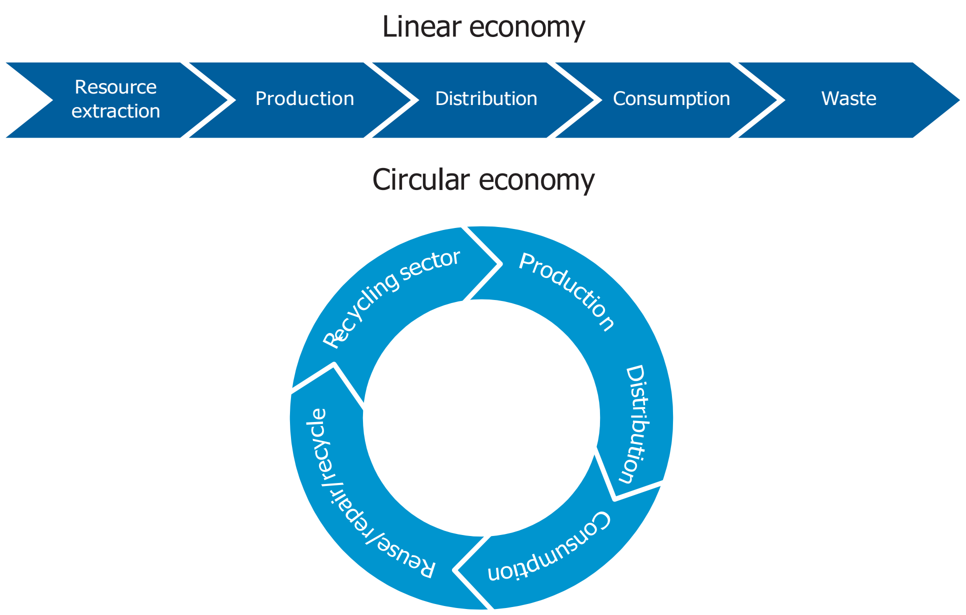
Outline of the concept of the circular economy and models of implementation

This section introduces the concept of the circular economy by discussing existing definitions and models of implementation. It also explains the linkages to a number of related concepts and global and European initiatives, and to WHO programmes and publications. It provides essential background to the subject and a foundation for the subsequent discussion and analysis of the health implications of the circular economy. Further detail and discussion on definitions, models and linkages can be found in Annex 1. Annexes 2 and 3 describe progress towards circular economy objectives and key national initiatives.

2.1 Definition

The circular economy is often presented in general terms as a transition from a linear (take, make, use, dispose) model to a circular (restorative and regenerative) model (EMF, 2015c) (Fig. 1). The literature, however, offers no single and ubiquitous definition, but a general consensus on the central concepts and aims of a circular economy. There are two kinds of definitions: those that are resource oriented and focus on the need for closed loops of material flows and reduced consumption of virgin resources, and those that go beyond the management of material resources to incorporate

Fig. 1. The linear economy and the circular economy

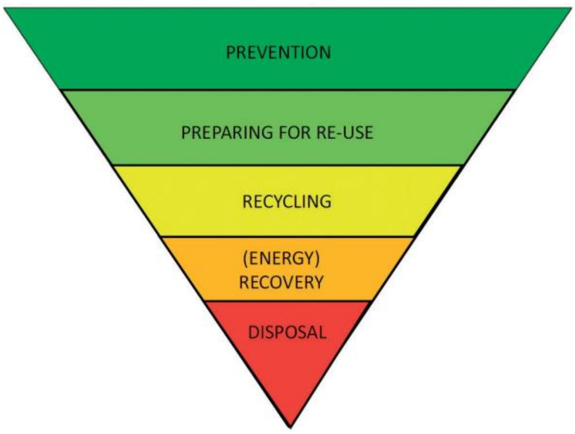


Source: AkzoNobel (2015).

additional dimensions, such as changing models of consumption (Rizos et al., 2017).

A frequently quoted definition by the Ellen MacArthur Foundation (EMF) sees a circular economy as: "one that is restorative, and one which aims to maintain the utility of products, components and materials and retain their value" (EMF, 2015c; EEA, 2016). The EU action plan for the circular economy describes a transition "where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised" (EC, 2015b). A key focus is thus on minimizing the need for new inputs of materials and energy, and reducing the environmental pressures related to resource extraction, emissions and waste. A guiding principle for the minimization of waste in a circular economy is the waste hierarchy, in which actions to reduce and manage waste are given an order of preference (Fig. 2).

Fig. 2. The waste hierarchy



Source: Bourguignon (2017).

In simple terms, the types of processes needed for a transition to a circular economy can be categorized as: using fewer primary resources, maintaining the highest value of materials and products, and changing utilization patterns.
In practice, the actions needed to achieve this transition include: recycling; efficient use of resources; utilization of renewable energy sources; remanufacture, refurbishment and reuse of products and components; extension of product life; product as service; sharing of products;[1] and waste prevention, including innovations to design out waste in products and a shift in consumption patterns (Rizos et al., 2017; EMF, 2015a). Alongside these actions, the phasing down of incineration and landfilling as options for waste management is seen as a requirement, although the best options for dealing with residual waste still need assessment.

The concept of the circular economy is often presented, including in the EU action plan, as enabling wider economic and social benefits, such as greater well-being, sustainable growth and employment. The main definitions reviewed for this report, however, did not explicitly mention health. Rizos et al. (2017) found that the existing conceptualizations of the circular economy do not include social aspects. A report from the European Environment Agency (EEA) (2016) gives a description that includes the potential for wider social benefits: "A circular economy thus provides opportunities to create well-being, growth and jobs, while reducing environmental pressures". An addition explicitly including health, alongside well-being, provides a useful definition for this report; it places health issues as integral to circular economy transition.

[1] Product sharing platforms take a variety of forms, including business to business, business to consumer and consumer to consumer; see the discussion in Frenken & Schor (2017).

2.2 Models

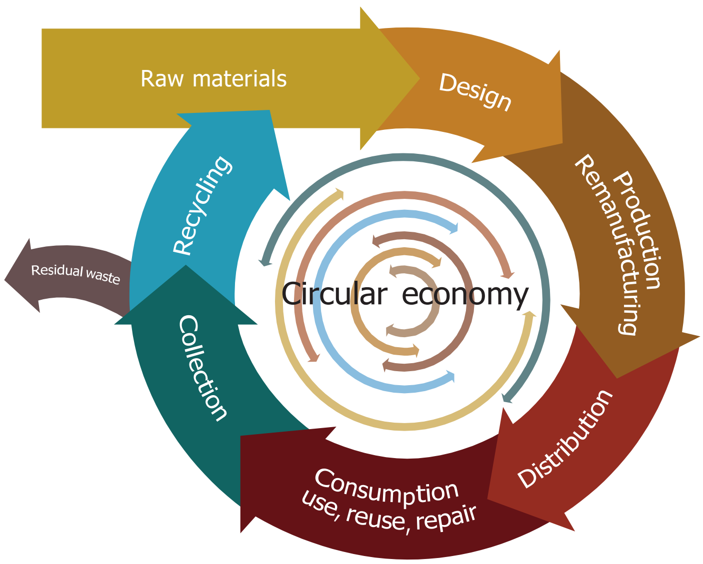
As with definitions, models of the circular economy vary in scope and sophistication. For example, Fig. 3 shows a simple circular concept, which describes a loop including production, consumption and reuse/repair/recycling. More complex representations include that developed by EMF (2015a), which outlines in greater detail the principles of:

1. preserving and enhancing natural capital by controlling finite stocks and balancing renewable resource flows;
2. optimizing resource yields by circulating products, components and materials at the highest utility; and
3. fostering system effectiveness by revealing and designing out negative externalities.[2]

Annex 1 provides a more detailed discussion of models of the circular economy.

A number of frameworks also set out processes and actions needed for a transition to a circular economy (Benton & Hazell, 2013; EMF, 2015c; Preston, 2012). For example, EMF uses the Regenerate, Share, Optimise, Loop, Virtualise, and Exchange (ReSOLVE) framework, which identifies six types of actions that businesses and governments can take. Such frameworks present a transition that requires an integrated effort by different stakeholders. These include a role for the state in setting strategy and regulatory and fiscal frameworks, and in funding some measures such as research and business support. Business plays a crucial role in implementing circular economy principles, including through innovation, while NGOs and business associations support this via promotion and knowledge sharing.

Fig. 3. Simple model of the circular economy



Source: EC (2015b).

[2] Negative externalities refer to any consequences of an economic activity that affect other parties without this being reflected in market prices. In this context, externalities with health implications include air, water, soil and noise pollution, and the release of toxic substances.

2.3 Related concepts and initiatives

A number of related concepts and associated global and European initiatives are linked with the circular economy concept. These include the following, outlined in greater detail in Annex 1.

The circular economy can be seen as a means of progressing towards **sustainable development** through achieving the SDGs (United Nations, 2018). The EU action plan for the circular economy (detailed in section 3) explicitly links the circular economy to the implementation of global commitments under the SDGs, particularly SDG 12 for ensuring sustainable consumption and production patterns (EC, 2015b). Some sources also see the transition to a circular economy as contributing to other SDGs, such as SDG 3 for good health and well-being (EMF, 2017a).

The working definition of a **green economy** provided by the United Nations Environment Programme (UNEP)[3] is "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011). Thus, it is interlinked with the circular economy, in particular in its low-carbon approaches and resource efficiency, but has been interpreted as being wider in range, as it includes social and ecosystems dimensions. References to the circular economy in UNEP green economy documents focus mainly waste and the use of materials. The green economy is also closely linked to sustainable development and is seen as a tool for achieving sustainable development in the 2012 Rio+20 agenda (United Nations, 2012).

The **Batumi Initiative on Green Economy** (UNECE, 2016) is a set of voluntary commitments by European countries and organizations to undertake actions for a green economy. It includes actions for the circular economy, and serves to enable the Pan-European Strategic Framework for Greening the Economy 2016–2030 (Green Growth Knowledge Platform, 2018).

The circular economy is also closely linked to the concept of and initiatives on **resource efficiency**. The EU Resource Efficiency Roadmap (part of the Europe 2020 strategy) outlines the circular economy as an interlinked initiative in terms of sustainable materials management where waste becomes a resource (EC, 2011b). The EU action plan for the circular economy also links the circular economy to the implementation of global commitments under the Group of 7 (G7) Alliance on Resource Efficiency.

The transition towards a competitive **low-carbon economy** largely focuses on the supply side of economies. The European Commission (EC) roadmap for moving to a competitive low-carbon economy sets a target for the EU of cutting GHG emissions to 80% below 1990 levels by 2050, and outlines required contributions across all main sectors responsible for the EU's emissions (EC, 2011a). It foresees health benefits owing to improved air quality. Low-carbon approaches are included in the circular economy model (and the green economy concept) but have a narrower focus.

The **bioeconomy** is defined as the parts of the economy that use renewable biological resources from land and sea, such as crops, forests, fish, animals and micro-organisms, to produce food, materials and energy. The EC bioeconomy strategy proposes a comprehensive approach to address the ecological, environmental, energy, food supply and natural resource challenges faced by Europe (EC, 2012). This concept is the focus of a key element of the circular economy model, which includes optimizing resource yields in biological cycles, as well as technical cycles, as outlined in principle 2 of the circular economy model developed by EMF (see Fig. A1.2).

[3] UNEP launched the green economy initiative in 2008. It includes global research and country-level assistance aimed at motivating support for green economy investments as a way of achieving sustainable development.

2.4 Linkage to existing WHO programmes and publications

A number of key WHO initiatives and publications connect to and are affected by circular economy aims and policies, primarily in the area of the green economy, environment and sustainable development. These include the following.

WHO briefings on **health in a green economy** review the health effects of mitigation strategies for climate change and identify expected health co-benefits, including from waste management (WHO, 2018). They note that other effects may involve health risks or trade-offs.

The transition to a circular economy has implications for the stated priorities of **Health 2020,** the European health policy framework adopted by Member States in the WHO European Region in September 2012 (WHO Regional Office for Europe, 2013). These priorities include: tackling Europe's major disease burdens, strengthening people-centred health systems and public health capacity, and creating supportive environments and resilient communities. The circular economy may affect the burden of disease both positively (e.g. though reduction of air pollution due to transition to circular economy mobility and production modes; see section 5) and negatively (e.g. if hazardous chemicals are not managed to minimize health risks; see the case study in section 7). The circular economy can contribute to improving the delivery of public health and health care services by providing a range of cost-saving and efficiency measures (see the case study in section 7). The transition to the circular economy can promote supportive environments and resilient communities to the extent that this translates into improved well-being and quality of life (see the discussion on models of a circular economy and examples in the case study on the built environment in section 7). Successful health outcomes for the populations of Europe resulting from progress towards Health 2020 will also support a healthy workforce, which is required for successful development of a circular economy.

The most recent fruits of the **European Environment and Health Process (EHP)**, the EHP Roadmap towards the Sixth Ministerial Conference on Environment and Health (WHO Regional Office for Europe, 2015a) and the Declaration of the Conference (WHO Regional Office for Europe, 2017b), include a focus on waste. The Declaration states that progress on actions to improve the environment and health "can be accelerated and sustained by enhancing interdisciplinary research and supporting the transition to a green and circular economy as a guiding new political and economic framework". In particular, the objective to "prevent and eliminate the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites" includes "supporting the transition to a circular economy using the waste hierarchy as a guiding framework to reduce and phase out waste production and its adverse health impacts through reduction of the impact of substances of greatest concern" (WHO Regional Office for Europe, 2017b).

3

Review of the current implementation of the circular economy concept in the WHO European Region

This section briefly outlines current progress in implementing the circular economy concept in Europe. It includes information on action by the EU and countries, research programmes and business and NGO initiatives. It also includes basic data on the progress towards circular economy objectives that results from waste management practices. The aim is to provide further background on current developments in Europe and to review the extent to which they have included health issues.

The circular economy concept has achieved wide engagement from the academic, policy, business and NGO communities over recent years. The current implementation of its principles encompasses a great range of activities. Much of the information provided here refers to activities of both the EU and its Member States, although where possible the state of play in other countries in the WHO European Region is also given. In addition, key international organizations are very active in supporting projects and greater knowledge on the circular economy, including EEA (2016), OECD (2017), the United Nations Industrial Development Organization (UNIDO) (2018) and the World Economic Forum (2018). Table 1 presents an overview of policy options, and the discussion is continued in section 8.

Table 1. Overview of types of policy options for the circular economy

Policy types	Examples
Regulatory frameworks	EU and national strategies for Member States in the WHO European Region, including targets, e.g. the EU action plan on circular economy. Product standards and regulations, e.g. the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation Waste regulations, e.g. the EU Waste Framework Directive, the EU Waste Electrical and Electronic Equipment Directive and related national legislation Industry and consumer regulations, e.g. on food safety
Economic instruments	Consumer incentives, e.g. reductions in value-added tax (VAT) for circular products Tax shift from labour to resources, e.g. landfill tax Financial support to business, e.g. subsidies, financial guarantee.

Table 1. contd.

Policy types	Examples
Education, information and awareness	Public communication and information campaigns Business collaboration platforms for information and best practice sharing, e.g. the Alliance for Circular Economy Solutions (ACES) Technical business support for advice, training and demonstration projects NGO information and awareness initiatives
Research and innovation policy	Research and development programmes, e.g. the EU Horizon 2020 projects on the circular economy, the European Cooperation in Science and Technology (COST) programme, the EU Circular Impacts project, projects of international development banks
Public procurement	Public investment in circular economy facilities, e.g. recycling collection and processing infrastructure Circular economy standards in procurement law or guidelines, e.g. strategy of the Danish Government for intelligent public procurement

Source: adapted from policy option categorization for the circular economy in the Circular Impacts project, EMF (2015a) and Preston (2012).

3.1 EU action plan for the circular economy

In policy terms, the **key European development** is the adoption of the EU action plan for the circular economy (EC, 2015b). This interprets the circular economy more broadly, seeing it as going beyond waste and environmental policy to include innovative forms of consumption and moving away from exclusive ownership, e.g. towards sharing/leasing products or infrastructure, and consuming services rather than products (EC, 2015b). The EC withdrew its earlier legislative proposals on the circular economy in 2014, and presented a new circular economy package in 2015 that covered the full economic cycle, not just waste reduction targets (European Parliamentary Research Service, 2016). The action plan sets out a timeline for actions in terms of:

- production, e.g. product requirements under the Ecodesign Directive, and guidance for industrial sectors in the reference documents on the best available techniques;
- consumption, e.g. the Regulatory Fitness and Performance Programme of the EU Ecolabel scheme, and action on green public procurement;
- waste management;
- the market for secondary raw materials;
- sectoral actions on plastics, food waste, critical raw materials, construction and demolition, biomass and bio-based materials;
- innovation; and
- investments and monitoring.

The legislative proposals set targets for the reduction of waste and establish a long-term path for waste management and recycling. Key targets for achievement by 2030 include: common EU targets for recycling 65% of municipal waste and 75% of packaging waste, and a binding target to reduce landfill to a maximum of 10% of municipal waste. The targets for municipal waste are mandatory, while others depend on translation or ratification in national law and vary between EU Member States.

Key legislative elements for waste include reviewing the targets in a number of directives (2008/98/EC on waste, 94/62/EC on packaging and packaging waste, and 1999/31/EC on the landfill of waste) and amending other directives (2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EC on waste electrical and electronic equipment). The report on the implementation of the circular economy action plan (EC, 2017b) sets out recent progress, and the ACES (2017) report card evaluated progress on the action plan independently. The action plan acknowledges that proposed options must "preserve the high level of protection of human health and the environment" but does not elaborate on the health-related aspects of the actions (EC, 2015b).

The EU action plan includes plastics among its key priorities and the EC recently adopted a "strategy for plastics in a circular economy" to protect the environment from plastic pollution while fostering growth and innovation (EC, 2018b). This includes explicit references to the potential threats to the environment and human health posed by plastic leakage.

3.2 National circular economy initiatives

A number of European countries – such as Denmark, Finland, Luxembourg and the Netherlands – have embarked on policy initiatives for a circular economy. Annex 4 outlines key national initiatives – including visions, roadmaps, strategies and action plans – in European countries and other global leaders, such as Canada, along with some examples of city and regional initiatives, such as those in Amsterdam and Brussels. In addition, a raft of national legislation on waste, resource efficiency and other relevant topics across European countries promotes circular economy principles without being assembled under this banner. For example, although Sweden does not currently have a roadmap or vision naming the circular economy, it strives to be a leader in innovative and sustainable industrial production through its "smart industry" vision, which includes encouraging circular economy business models (Government Offices of Sweden, 2016). Similarly, the German Resource Efficiency Programme includes developing and expanding the circular economy as a guiding principle.

A review of circular economy initiatives in the European Region indicates that most of the countries identified as leading in this field are EU Member States, particularly those in western and northern Europe. Evidence of high-level, dedicated circular economy initiatives in central and eastern European States is limited, although related actions are being developed in a number of different contexts. For example, among the countries participating in the Batumi Initiative on Green Economy, some in central and eastern Europe acknowledge the benefits to a circular economy from their proposed actions, although these do not principally focus on making the transition (Green Growth Knowledge Platform, 2018). Most of these countries are EU Member States; for example, Estonia names the transition towards a circular economy as a co-benefit of its low-carbon development strategy up to 2050. The policy on energy efficiency in the housing sector in Lithuania flags its relevance to the circular economy, and the revision of the natural resource tax system in Latvia includes specific requirements on waste management that are described as assisting the transition to a circular economy.

This study found few direct references to the circular economy in proposed actions among the non-EU countries participating in the Batumi Initiative, except in Azerbaijan, where it is mentioned in the context of strengthening the implementation of the environmental dimensions of the SDGs. In addition, the Regional Environmental Centre for the Caucasus is committed to wide-ranging action for the "promotion of circular economy in South Caucasus region", including a focus on "shifting consumer behaviours towards sustainable consumption patterns and developing clean physical capital for sustainable production patterns" (UNECE, 2016). Further research is needed to clarify the understanding of the reasons for the relatively limited current development of circular economy initiatives in central and eastern European countries and to identify more details of their government, business and NGO activity that are related to the circular economy.

In addition, while national initiatives (outlined in Annex 4) state the importance of health in in their visions for circular economies, they do not in general focus their analyses and actions on health in any detail. For example, a review found that Nordic Co-operation reports on the circular economy acknowledge health as an issue for consideration but give no further assessment or examples (e.g. Nordic Council of Ministers, 2015). One exception is the Luxembourg roadmap for a circular economy, which includes examples of the need for healthy materials and a section on health care (EPEA, 2014).

Outside Europe, Canada and China give key examples of national strategies for a circular economy. Japan is seen as a pioneer in recycling, although it does not have a circular economy strategy or vision, but focuses on waste management regulation, which often takes a product life-cycle approach (Ministry of Environment, 2018). The United States of America has no specific national policy to promote the circular economy, although there are a number of relevant measures at the state and local levels, such as the Green Building and Green Points Program for sustainable construction in Boulder, Colorado.

3.3 Research and innovation programmes

EC research programmes supporting the circular economy include: Horizon 2020, which includes a programme on the circular economy and sustainable process industries (EC, 2016c); Circular Impacts, an EU-funded research project; and the REBus project, pioneering resource-efficient business models for a circular economy.

The European Investment Bank (EIB) is a key player for circular economy investments in the EU, co-financing projects related to sustainable and economic growth, competitiveness and employment worth €2.4 billion in the last five years (EIB, 2018). Rizos et al. (2017), however, found that research on the circular economy is fragmented across various disciplines and often shows different perspectives on and interpretations of the concept and related aspects.

3.4 Business and NGO initiatives

As mentioned, business can play a crucial role in progress towards the circular economy, particularly by developing innovative circular approaches to production and consumption. In business, the term circular economy often emphasizes the engineering and design challenges for the relevant industry. Waste management companies in Europe (e.g. SITA United Kingdom and Veolia Environment) use the term widely, although many companies have implemented policies that are consistent with the concept but use different terminology (Preston, 2012).

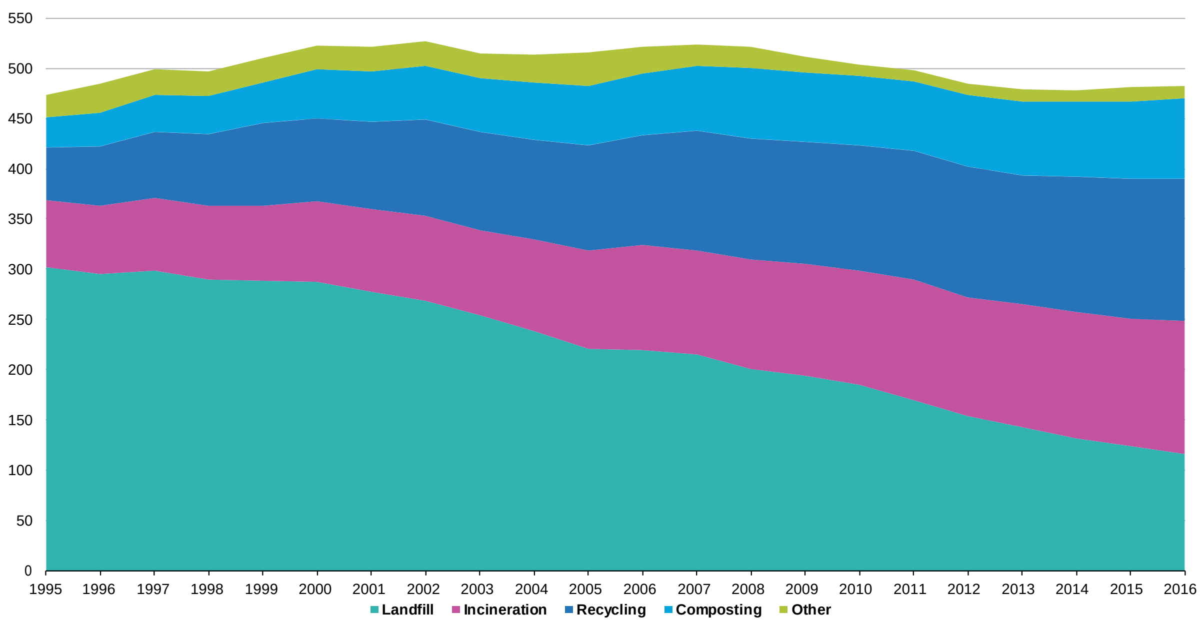
A wide variety of organizations and business and NGO networks have been established in recent years in Europe to promote, research and share knowledge and experience on the circular economy, such as EMF (United Kingdom), ACES, Circle Economy (the Netherlands), Circular Change (Slovenia), the Foundation for Circular Economy (Hungary), the Circular Economy Institute (France) and the Green Alliance (United Kingdom). Some of these, such as the Aldersgate Group (United Kingdom), also promote the circular economy at the policy level, particularly regarding the EU action plan. A review of these networks and organizations' work for the circular economy (see Annex 3) yielded very limited evidence of engagement in health-related issues. Organizations acknowledge human health as an issue in the transition to the circular economy, but with little elaboration or research. Organizations addressing health issues in the circular economy include the Health and Environment Alliance (awareness raising and advocacy on toxic substances, endocrine disrupting chemicals and disease prevention) and the Chemicals Health and Environment Monitoring (CHEM) Trust (chemical toxicity issues in the circular economy).

3.5 Progress towards circular economy objectives

As to practical progress towards circular economy objectives, the EU showed an overall decline in waste generation of about 7% in 20042013, with a decrease of 4% in municipal waste generation; caveats are needed, however, due to missing data, uncertainties and differences in waste calculation methods between countries (WHO Regional Office for Europe, 2016b). Fig. 4 shows overall trends in municipal waste treatment for the EU as a whole in 1995–2015: gradual declines in landfill and gradual increases in recycling, composting and incineration.

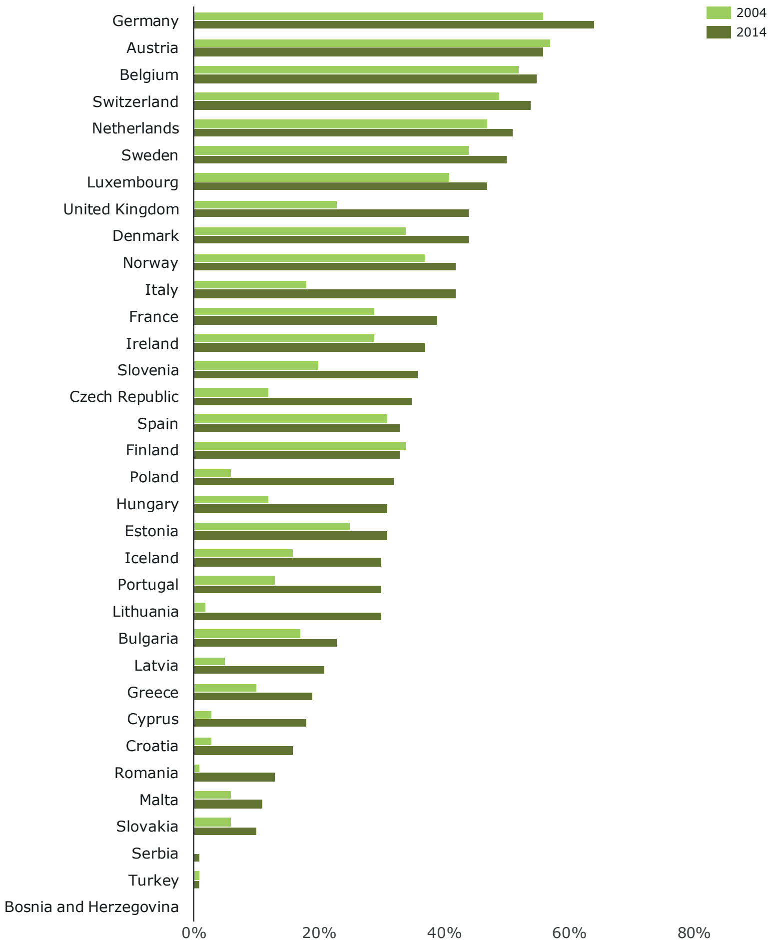
Countries vary significantly, however; many of those that more recently joined the EU have lower recycling and composting rates and much greater use of landfills, as shown in Fig. 5. A review by the WHO Regional Office for Europe (2016b) indicated large differences between and within European countries on waste management practices; some countries had old technologies and high levels of informal disposal, including open-air dumping and burning of waste. Annex 2 provides further details on the declining trends in municipal waste generation in most EU countries and the increases in the percentages of municipal waste recycled and composted in Europe over recent years (Eurostat, 2018b).

Fig. 4. Methods for municipal waste treatment in the EU (kg per capita), 1995–2015



Source: data from Eurostat (2018b).

Fig. 5. Comparison of municipal recycling and composting rates in European countries, 2004 and 2014



Source: EEA (2016b).

4

The circular economy and health: macroeconomic and distributional perspectives

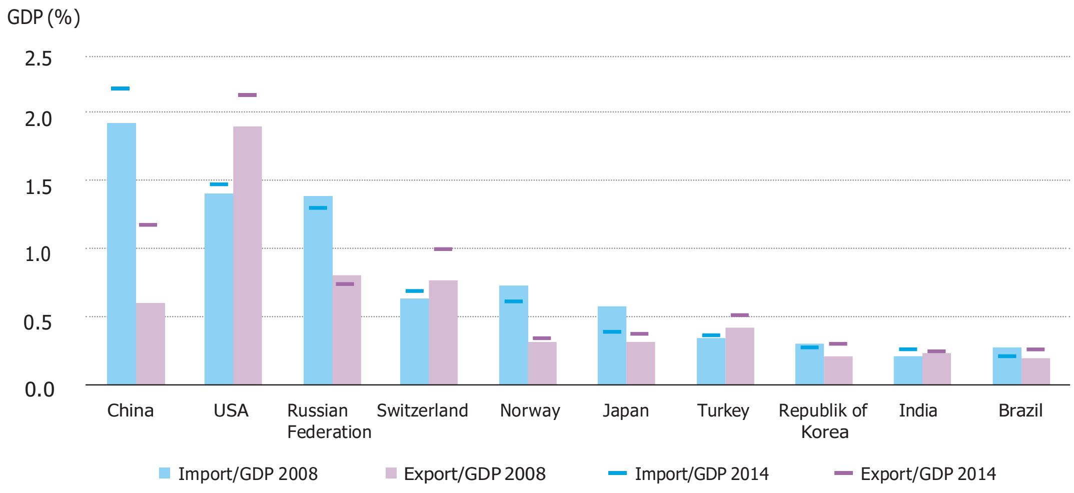
This section provides an overview of a number of the link between the operationalization of the circular economy in the broader economic and distributional context, and its implications for human health. It therefore provides the background for deriving a framework for the analysis of health effects relating to the circular economy (section 5) and for the identification of specific health effects (section 6).

4.1 Macroeconomic perspective

4.1.1 Global trends

At the macroeconomic scale, perhaps the most important trend to affect circular economy initiatives is globalization: the increased interdependence of countries and world regions for financial, human and material resources, as transport and communication costs have fallen. Fig. 6 provides evidence of this trend: trade between the EU and its 10 top trading partners increased as a share of gross domestic product (GDP) from 2008 to 2014 in almost all cases.

Fig. 6. EU trade in goods, imports and exports (% of GDP) for 10 main trading partners, 2008 and 2014



Source: data from Eurostat (2018a).

One likely consequence of this trend is that technological innovations that have arisen from strategies for resource reuse and reduction in circular economy initiatives in one country are more likely to be exported to others. As a result, economies of scale in manufacturing can be realized, further increasing the competitiveness of technologies. On the basis of this logic, EMF (2015b) estimates that, by 2030, the annual benefit of adopting advanced circular economy technologies, rather than current technologies, could be €1.8 trillion. This technological diffusion will then have broader health consequences than would otherwise be possible. The global adoption of digitization in communication and other technologies is likely to further amplify these trends.

The same advantages are likely to apply to the diffusion of technological innovations in pollution abatement that, when adopted, result in reducing the associated health impacts.

Other things being equal, the growth of world trade – including in technology that enhances the circular economy – would suggest that employment levels would also increase (Horbach et al., 2015). Higher employment in turn is understood to have both direct positive psychological and physical health benefits, and indirect benefits resulting from higher income, which allows the consumption of healthier food (see the case study in section 7) on food safety and healthy foods). Further health benefits associated with GDP growth resulting from globalization stem from the fact that increased expenditures on both public and private health care could be facilitated.

Contrary to this positive view of globalization and its relationship to circular economy initiatives and their health consequences, one tangible disadvantage of this trend is that comparative advantage encourages higher-income countries to export their waste – as well as polluting production – to lower-income countries. The case study on e-waste that is exported to dumping and processing plants in developing countries (section 7) illustrates the negative health consequences that may be associated with this trend. In addition, economic growth in countries dependent on exporting natural, nonrenewable resources could decline, resulting in lower levels of public health provision (OECD, 2017).

Further, globalization is likely to exacerbate the health impacts from emerging chemicals of concern (see case study in section 7) "by the increasing movement of chemical production to low-income and middle-income countries where public health and environmental protections are often scant. Most future growth in chemical production will occur in these countries" (Landrigan et al., 2017).

4.1.2 Macroeconomic indicators

A further positive trend that is particularly strong in higher-income countries relates to how the size of the economy is characterized. Specifically, awareness is growing that conventional measures of economic activity have a somewhat limited ability to capture other dimensions of human well-being and environmental constraints. For example, patterns of sustainable production (resulting in less material output) and sustainable consumption (in which fewer material products are consumed) are likely to be recorded as negative impacts on conventional measures such as GDP, even though they facilitate a transition to longer-term environmental and economic sustainability. Thus, the adoption and monitoring of a range of indicators of sustainable development, such as that undertaken by the EU statistical office, Eurostat (2015), as part of the EU Beyond GDP initiative, is an essential first step in better incorporating incentives for the circular economy in broad macroeconomic policy planning. Ultimately, given the extent of globalization, economic indicators and incentives need to be aligned at the international level, in order to avoid both pollution havens like those in the e-waste case study and overexploitation of natural resources more generally.

A further example of the rather limited value of GDP as a measure of welfare arises from the observation that pollution is often associated with health impacts that have both market and nonmarket costs. Market costs include those for health treatment, which would increase the GDP of the country in which people are treated but are effectively incurred to restore health after pollution affects it. Moreover, these costs are not trivial: Landrigan et al. (2017) estimate that health care spending on diseases caused by air pollution amounted to 3.5% of total health expenditure in high-income countries in 2013. In Sri Lanka, the only low- or middle-income country for which data are available, health care spending on diseases due to air pollution accounted for an estimated 7.4% of health care spending in 2013. The other main market cost associated with pollution is lost productivity arising from ill health. For this component, Landrigan et al. (2017) estimate that the costs from pollution-related disease account for 1.3–1.9% of GDP in low-income countries, and only 0.05–0.1% of GDP in high-income countries. Finally, the nonmarket component recognizes that health has an effect on peoples' welfare that is independent of GDP. When the component of willingness to pay to avoid premature mortality is added to the other two components, the total is estimated to be more than US$ 4.6 trillion, equivalent to 6.2% of global GDP.

Irrespective of the need to update macroeconomic indicators, a further positive development is the recent trend in the use of macroeconomic models to investigate how the structure of the macroeconomy might change as a result of a transition to a more circular economy. Studies to date indicate a tentative finding that, even with the adoption of traditional macroeconomic indicators, the shift to a circular economy will have either a neutral or positive effect in aggregate (OECD, 2017).

4.1.3 Conclusions

This discussion of the ways in which macroeconomic dynamics can differentially influence the resulting health outcomes implicitly highlights the roles public policy may play in maximizing the net health benefits. Specifically, on the one hand, the analysis indicates a role for the state in incentivizing the development and adoption of technology that is compatible with natural resource reuse and reduction. On the other hand, market forces need to be sufficiently well managed to ensure that market prices fully internalize associated external health and other costs, and that compensation mechanisms operate effectively.

The discussion of macroeconomic indicators highlights the inadequacies of existing measures, such as GDP, in capturing the natural resource constraints and the effects on well-being of the health effects of pollution. Again, this suggests a continued need to fully measure the size of pollution externalities so that they may be wholly internalized in public policy design and expressed in market prices. It also emphasizes the need for a renewed effort to promote the use of a wider, more inclusive set of sustainable development indicators in policy evaluation.

4.2 Distributional perspective

This section outlines the nature of distributional effects of a transition to a circular economy with specific reference to the environment and health.[4] It covers actual or potential inequalities in health exposures and effects among different groups, particularly vulnerable groups.

4.2.1 Context

The overall context for understanding the distributional effects of the implementation of circular economy actions is that, in general, environmental health risks in Europe and globally disproportionately affect vulnerable groups. The Lancet report on pollution and health concludes that "pollution disproportionately kills the poor and the vulnerable" and that "in countries at every income level, disease caused by pollution is most prevalent among minorities and the marginalised" (Landrigan et al., 2017). A WHO Regional Office for Europe (2010) review of evidence on environment

[4] This section uses the terms distributional effects and inequality to describe actual or possible positive or negative health impacts on vulnerable groups, rather than equity or fairness. This is because distributional effects represent inequality in terms of absolute quantitative differences between groups, while equity is defined as a relative term, and how changes to health impacts on vulnerable groups affect overall impacts relative to other groups is not known.

and health risks and social inequalities concluded that "people living in adverse socioeconomic conditions in Europe can suffer twice as much from multiple and cumulative environmental exposures as their wealthier neighbours, or even more". Similarly, the review identified inequalities in exposure to environmental threats for vulnerable groups such as children and elderly people, low-education households, unemployed people, and migrants and ethnic groups (WHO Regional Office for Europe, 2010); key examples in various areas include the following.

Evidence indicates that more deprived populations tend to live closer to hazardous **waste management** sites and are more exposed to their emissions.

Although European evidence on poorer people's exposure is mixed, in general, those of low socioeconomic status experience greater health effects from **air pollution**.

Residential location is strongly associated with exposure to environmental risks, with vulnerable groups (especially those with low income) having increased exposure. This includes environmental risks in dwellings (e.g. chemical contamination, noise and lack of sanitation) and residential environment, closeness to polluted sites or exposure to traffic-related pollution). Studies show that vulnerable groups (especially those with low income) have increased exposure to these risks. Differences between rural and urban areas depend on the type of risk; for example, higher health risks in general are associated with fewer household connections for water supply and sanitary equipment in rural areas (especially in eastern Europe and the Caucasus) but greater risks from air pollution and noise in urban areas.

In the **work environment**, the least skilled workers have the greatest exposure to harmful working conditions, including exposure to physical, chemical and microbiological toxins. Education, income, immigration status, ethnicity and gender influence which populations obtain low-skilled occupations.

Differences in the capacity to adapt to **climate change** (for example, due to differences in wealth, technical knowledge, information, skills and infrastructure) may increase inequalities, for example, through heat-related health impacts, flooding and food-, water- and especially vector-borne diseases.

The overall pattern, based on the available fragmentary data, is that **children** living in adverse social circumstances suffer from multiple and cumulative exposures, are more susceptible to a variety of environmental toxicants and often lack environmental resources or access to high-quality health care to reduce the health consequences of environmental threats.

As to **gender**, inequities in the environment and health due to biological and sociocultural differences have been identified in the issues of safe water and sanitation, human settlements, exposure to chemicals, clean air and safe working environments, and climate change (UNDP, 2013). The available evidence shows marked differences between men and women in exposure and vulnerability (WHO Regional Office for Europe, 2009, 2010).

4.2.2 Identified distributional effects

A key question in this context is to what extent circular economy actions do and will alleviate or contribute to the environmental health risks for the vulnerable populations listed above. As noted in section 6.1, the literature has limited coverage of the indirect economic and social impacts of the transition to a circular economy, including impacts on gender, skills, jobs, poverty and inequalities. Moreover, within its discussion of social impacts, this literature has not focused much on health issues and the related distributional effects of such a transformation (Rizos et al., 2017).

Possible distributional aspects of these health issues emerging from the current study include both direct impacts from specific actions and indirect longer-term impacts from combinations of actions. The rapid assessment of the implications for human health from the implementation of circular economy actions given in Table 3 (section

6) includes very preliminary indications of likely affected groups and distributional issues for identified health impacts. This is based on expert judgement as, while the literature on the circular economy identifies these issues in some cases, specific research on the distributional issues for the identified health impacts is limited.

4.2.3 Specific circular economy actions

Direct health consequences resulting from **specific circular economy actions** outlined in this report include those discussed in the case studies on chemicals of concern, e-waste and food safety (see section 7). As noted above, the negative effects identified frequently fall disproportionately hard on vulnerable groups in Europe and globally.

A key example is the effect of the **export of waste**, particularly e-waste (see case study in section 7.3), to unregulated and informal dumping sites in developing countries, where the local population and site workforce is often more deprived than the general population (WHO, 2016b) and thus less able to afford defensive action. Since the recycling of electronic products and components has increased in recent years, the level of health risks at these sites could be attributed in part to circular-economy-related actions that are not yet effective in minimizing health externalities. Policies to address this issue include implementing and enforcing health and safety standards at these sites and cutting the amount of toxic material that goes to them by improved tracking and routing to safer options.

The transition to a circular economy can also play a key part in reducing the total amount of harmful substances in the waste stream in the long term. If these actions succeed and their wider consequences (such as impacts on livelihoods) are taken into account, they will cut health impacts and could benefit the poor, since the local and worker populations of unregulated dump sites would disproportionately experience these benefits. The health benefits from these actions would be lower per unit of hazardous material from the remaining e-waste that goes to other regulated sites, although there is an unknown equity impact around the issue of hazardous material (thought to be from recycling) turning up in products.

The direct health consequences of recycling chemicals of concern, such as the BPA and BFRs being detected in products (see case study in section 7.2) is an area of scientific uncertainty and continuing research. This uncertainty includes distributional effects, since exposures and effects would depend on the demographic profile of the workers producing and the consumers buying the products in question, such as children’s toys. Further specific circular economy actions may benefit the health of vulnerable groups, as identified in Table 3 (section 6), through the redistribution of edible food (given caveats on ensuring food safety standards), for example. Further research is needed in all the identified cases to improve the understanding of the implications for equity.

4.2.4 Indirect and longer-term impacts from combinations of circular actions

A successful transition to a circular economy would result in reduced global environmental pollution (including emissions to air, water and soil) from production and consumption processes. This in turn would produce long-term indirect health benefits to the extent that global environmental pollution is reduced.

The case studies on the built environment, climate change and air pollution in section 7 discuss examples of these benefits. Such benefits are likely to favour vulnerable populations because these groups are known to be disproportionately affected by environmental impacts due to inequitable environmental determinants of health, as outlined above. Further research is needed, however, to understand the distributional and equity implications in greater detail, including more precisely how circular economy processes affect the environmental conditions and health of poor people in more polluted locations in the world.

4.2.5 Conclusions

The human right to the highest attainable standard of health is enshrined in the WHO Constitution (WHO, 2017b) and the United Nations Convention on the Rights of the Child, which explicitly links the right to health with pollution and contamination (United Nations, 2016). This right underlines the importance of understanding the distribution of health impacts in the context of the circular economy. The negative health consequences of specific circular economy actions outlined in this report may disproportionately affect more vulnerable populations, as shown by the case on studies chemicals of concern, food safety and e-waste. On the other hand, the health benefits of the actions are likely to disproportionately favour vulnerable populations by addressing inequitable environmental determinants of health, such as air pollution and soil contamination.

Given the importance of inequity in health in key initiatives, such as Health 2020 and the SDGs (WHO Regional Office for Europe, 2013; United Nations, 2016), the distributional issues outlined in this report require further emphasis in research and policy development, to minimize negative outcomes and promote positive outcomes for vulnerable populations.

5

Outline of a framework for assessing health impacts in the circular economy model

This section develops a framework to identify pathways through which implementation of circular economy models may affect human health and welfare. The framework is designed to describe the health and welfare impacts identified according to their key characteristics, including the type of effects (positive/negative, direct/indirect) and the economic sectors and groups affected (distributional issues). To the extent possible, the framework draws on and adapts existing frameworks and classifications from the environment and health literature, including from WHO initiatives.

The Driver, Pressure, State, Exposure, Effect, and Action (DPSEEA) framework is a useful tool for mapping links and causal relationships between the political, social and economic drivers of environmental pressures and states, and their effects on health exposures and impacts, as a basis for identifying policy actions for better health and environments. WHO developed the DPSEEA framework from a more general environment-based framework to focus specifically on links between the environmental and health (Corvalán et al., 2000; WHO, 2008).

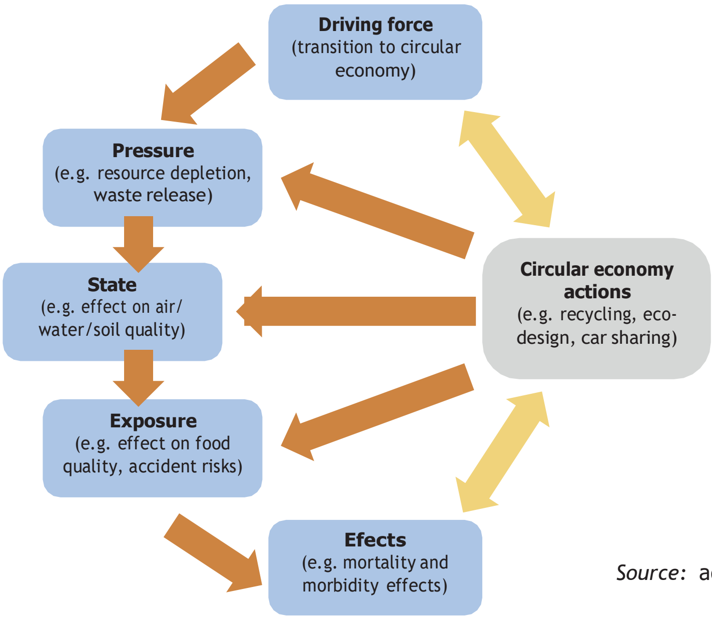
In the context of assessing the health implications of the transition to a circular economy, this framework can be adapted so that, rather than being used to identify policy actions, the range of possible processes needed for a transition to a circular economy (e.g. recycling, reuse, product sharing, etc.) is already defined.[5] The health impacts of implementing these processes can then be mapped according to their links with different elements of the framework, as shown in Fig. 7. Thus, some processes (such as recycling chemicals of concern) can be identified as directly affecting health exposures and effects, and others as doing so indirectly; an example of the latter could be when greater resource efficiency results in reduced environmental pressures from resource extraction and use, which then result in improved environmental conditions and reduced health exposures and effects. These impacts may appear far away from the areas where action is taken; for example, greater resource efficiency may have health implications in locations where source materials are mined, including in developing countries. Feedback loops may also occur: unintended negative health effects from circular economy processes can result in adjustments to policy on these processes. Similarly, initiatives for a circular economy drive the uptake of its processes, and their implementation can positively and negatively affect the overall drive for a transition to a circular economy.

The consideration and characterization of the possible implications for health of circular economy processes (section 6) uses the

[5] Note that this publication uses the term processes (as used in Rizos et al. 2017), as it focuses on the health implications of the increased use of these processes rather than the policy actions that might bring them about (e.g. regulation, economic incentives, awareness raising). The latter are discussed further in section 6.

framework described here. In particular, it aided the identification of where and how circular economy processes link to other elements in the DPSEEA framework and where there are real or potential health exposures and impacts as a direct or indirect result.

Fig. 7. The Drivers-Pressures-State-Exposure-Effects-Actions/DPSEEA framework is a framework for linkages between health, environment and development



Source: adapted from Corvalán et al., 2000; WHO, 2008.

Fig. 8 presents a framework for identifying and characterizing the potential health impacts of each circular economy process according to:

- the **category of the circular economy process or action (consumption or production)**, using categories defined in Rizos et al. (2017), as shown in Table 2;
- the **source of potential impact on or change in risk** and whether the change is positive or negative: for example, when recycling of chemicals of concern in food packaging (e.g. BPA, phthalates and perfluorinated chemicals – PFCs) causes a potentially negative impact;
- the **types of health impact**: characterizing health impacts of circular economy processes according to their causal links in the DPSEEA framework: that is, whether they result indirectly from changed environmental pressures and state (e.g. changes in air quality) or directly from health exposure (e.g. via pathways of inhalation or ingestion) and effect/endpoints (e.g. from direct exposure to chemicals of concern);[6]
- the **nature of the health impacts**: identifying real or potential positive and/or negative health endpoints (the epidemiological nature of health impacts[7]) and whether they concern occupational, public or consumer health;

[6] Where applicable, the relevant type of environmental links is identified, such as changes to air, water or soil quality; GHG emissions; and noise.
[7] Health impacts are defined with reference to the epidemiological categories used in the WHO study on preventing disease through healthy environments by Prüss-Üstün et al. (2016).

- the **economic sectors** in which the impact is associated with particular production processes or services, such as agriculture, industry or commerce (such as plastics, electronics, chemicals and food production), transport and housing or the built environment.
- the **affected groups and distributional issues**: indicating, where possible, race, poverty and inter- and intragenerational equity issues where there are specific occupational, public and consumer health impacts.

Fig. 8. Framework for identifying health impacts of the circular economy

Category of process or action (consumption or production), such as reduced use of primary resources (production)

↓

Type of process or action, such as recycling, efficient use of resources

↓

Source of potential health impact (positive/negative/research gap), such as recycling of chemicals in food packaging (negative impact)

↓

Type of impacts in DPSEEA context

Direct (such as exposure to chemicals of concern)	Indirect (such as change in air quality due to reduced emissions from production and consumption)

Nature of potential health impact (such as epigenetic effects)

Sectors affected (such as retail, food, waste management)	Affected groups or distributional issues (such as waste sector workers, children)

Source: data from Rizos et al. (2017)

Table 2. Categories and types of circular economy processes and actions

Category (consumption or production)	Type
Reduced use of primary resources (production)	Recycling Efficient use of resources Use of renewable energy sources
Maintain the highest value of materials and products (production)	Remanufacturing, refurbishment and reuse of products and components Product life extension
Change utilization patterns (consumption)	Product as service Sharing models Shift in consumption patterns

Source: data from Rizos et al. (2017)

6

Health implications/ impacts of circular economy

6.1 Review of potential health impacts

This section presents a rapid assessment of the known and potential health implications of a transition to a circular economy based on a review of the literature. Table 3 gives an overview of real and potential health implications that have been identified by literature review and using the framework developed in section 5. This includes the identification of the most significant existing and potential health impacts, the stakeholders affected and distributional effects. Table 3 uses simple colour coding to indicate the positive and negative health implications identified in the literature. The existence and extent of identified impacts depend heavily on context, and research is limited in many cases, so no scaling of impacts is given. Table 3 also notes where the evidence of impacts remains inconclusive or limited. Thus, the rapid assessment is necessarily very generalized and not comprehensive; rather, it is intended to demonstrate the wide-ranging nature of potential impacts and whether the emerging literature has identified them as positive or negative. Further expert review is needed to assess the quality and extent of the available evidence per impact, and their relative importance.

Health issues are included in but not at the forefront of a number of the circular economy reports reviewed for this publication. Most studies on the circular economy issued to date focus primarily on the business case for enhanced resource efficiency (Wijkman & Skånberg, 2015). The review by Rizos et al. (2017) found limited information on the indirect effects on the economy and the social impacts of the transition to a circular economy, such as impacts on gender, skills, jobs, poverty and inequalities. Moreover, the reports that have looked at the social benefits that a transformation to a circular economy would entail focused mainly on other aspects, rather than directly on health impacts. For example, the report of the Green Alliance (2015) on the social benefits of a circular economy focuses on jobs and other economic benefits, but does not cover health. Similarly, the Club of Rome's reports on the benefits for society of a circular economy in Europe (Wijkman & Skånberg, 2015, 2016) focus on carbon emissions and employment benefits, with limited coverage of health.

Other literature covers the health effects of waste management options; publications of the WHO Regional Office for Europe (2007, 2016b) outline key issues, with reviews available on health impacts of waste treatment activities. The general conclusion given in WHO Regional Office for Europe (2016b), however, is that the health effects of waste management and disposal activities are only partly understood and definitive results, including accurate exposure information, are lacking in many cases. Much more comprehensive evidence is therefore needed to better inform the policy debate.

Table 3. Rapid assessment of human health and welfare implications from implementation of circular economy models

Process/Action	Source of potential health implications positive or negative	Health impact (direct or indirect)	Nature of potential health endpoint
Reduced use of primary resources (production)			
Recycling	Food waste: redistribution of edible food	Direct health effects	Reduced malnutrition and other poor diet related endpoints
	Food waste: composting	Direct health risks from inhalation of bioaerosols	Asthma or extrinsic allergic alveolitis
	Food waste: risk if food safety is compromised	Direct health effects	Food poisoning including diarrhoeal diseases (public health)
	Chemicals in food packaging (BPA, phthalates, PFCs)	Exposure to chemicals (direct)	Epigenetic effects
	Use of BFRs in manufacturing.	Exposure to chemicals (direct)	Endocrine, reproductive and behavioural effects
	E-waste recycling components (e.g. BFRs, PCBs)	Direct health effects and indirect impacts via soil, water and food, and toxic by-products	Contact with hazardous waste, increased risk of injury in recycling process
	Informal recycling	Occupational health risks at poorly regulated sites	Increased risk of accidents and exposure to hazardous materials
	Waste reduction and recycling in health sector	Direct impact on health sector via reduced costs	Reduced costs allow improved health services across all endpoints.
	Use of recycled materials in manufacturing processes	Indirect impact via reduced manufacturing air/water emissions	Cardiovascular and respiratory Heat-related conditions in climate change (long term)

	Sectors affected	Groups affected or distributional issues	Notes	Example sources
	Community	Low-income and vulnerable groups	Positive impact depends on safeguards on contamination and distribution of unhealthy foods.	Mabelis et al. (2016)
	Waste management	Waste sector workers	–	Pearson et al. (2015)
	Various including retail, catering, waste management	Vulnerable groups and community	Safety guidelines are available for food waste collection.	HSE (2018), WRAP (2016)
	Retail, catering, waste management	Consumers, waste sector workers	CHEM Trust and the Health and Environment Alliance (HEAL) are working on this issue.	Chen et al. (2009), DiGangi & Strakova (2015), Genualdi et al. (2014), Rodgers et al. (2014), Rudel et al. (2011)
	Plastics, retail, waste management	Consumers (eg children), waste plastics and sector workers	CHEM Trust is working on this issue.	–
	Community, waste management	Waste site workers and children are especially vulnerable.	–	Kuehr & Magalini (2013)
	Community, waste management	Disproportionately affects poor and vulnerable groups	This issue includes e-waste recycling sites and other waste sites and relevant to waste exports to countries outside Europe and any poorly regulated sites in Europe.	Ezeah et al. (2013)
	Health, manufacturing	All health sector users	–	EC (2017b), EMF (2015c), REBus (2016a–c).
	All sectors	Manufacturing sector workers, general population	Energy saving and lower emissions from using recycled materials in manufacturing process	EMF (2015a,b) includes analysis of carbon dioxide (CO_2) and pollution reductions,

Table 3. contd.

Process/Action	Source of potential health implications positive or negative	Health impact (direct or indirect)	Nature of potential health endpoint
Efficient use of resources	Use of sewage sludge in agriculture with contaminants (e.g. persistent industrial chemicals, pharmaceuticals, pesticides)	Change of soil/water quality	Wide range: eg typhoid, dysentery, diarrhoeal diseases
	Resource-efficient agricultural practices (including reduction in fertilizer and pesticide use), regenerative farming practices (including organic cultivation), closed loops of nutrients and other materials	Reduced pressures and states (indirect) and exposure (direct)	Reduction in poor-diet-related conditions, obesity, various cancers
Use of renewable energy sources	General move to renewable energy and energy efficiency in the circular economy across many sectors	Lower air pollutants and GHG (indirect)	Reduced cardiovascular and respiratory effects Reduced Heat-related impacts and exposure risks from extreme events from climate change
	Reduced energy recovery (incineration)	Reduced generation of pollutants during energy recovery process	Reduced cancers, respiratory and negative birth outcomes The evidence is not conclusive and research continues.
Maintain the highest value of materials and products (production)			
Remanufacturing, refurbishment, and reuse of products and components	"Circular buildings"	Improved indoor air quality and use of nontoxic materials	Various, including occupational health and safety issues, mental health and respiratory.
	Reuse of clothing and textiles	Reduced health risks, e.g. from cold or other harmful exposures	Lower risk from weather-related conditions

	Sectors affected	Groups affected or distributional issues	Notes	Example sources
	Agriculture, food production	Agricultural workers, consumers	There is potential risk but limited evidence of health impacts in the EU.	Risk & Policy Analysts Ltd et al. (2008)
	Agriculture, food production, consumers	Consumers Further research needed on distributional issues need	Overall potential effect is consumers having greater access to high-quality food that would encourage healthier dietary choices (see discussion in case study).	EMF (2015b)
	Multiple sectors	Positive for vulnerable groups, which are disproportionately affected by climate change and air pollution	The benefits should be balanced with any negative impacts, such as changes in land use, disposal of toxic materials from solar manufacturing.	EMF (2015b) and Deloitte (2016) focus of sources is on reducing CO_2 emissions.
	Waste management, energy	Workers, vulnerable groups near incinerators	Although Incineration is defined as partially renewable, it is not a favoured the circular economy option in the circular economy literature. Assessment is needed of the pro and cons of options for treatment of residual waste flows consistent with the circular economy principles.	Ashworth et al. (2014), Health Protection Scotland (HPS, 2009)
	Commercial and residential	Potential impacts for a wide range of groups	"Circular buildings" involve buildings made for looping, using renewable or recyclable healthy materials.	EMF (2015b, 2017b)
	Textiles, voluntary sector	Poor and vulnerable groups	See example of reuse of workwear for humanitarian aid blankets. Positive impact depends on safeguards against infection transmission.	Circle Economy (2016)

Table 3. contd.

Process/Action	Source of potential health implications positive or negative	Health impact (direct or indirect)	Nature of potential health endpoint
Product life extension	Reduced waste generation and production emissions	Reduced indirect impacts from waste management (landfill, incineration, recycling, etc.) and from manufacturing air/water emissions	Various, including reduced cancer, negative birth outcomes, and respiratory risks
	Resource savings through extension of product life in hospitals	Direct impact on health sector via reduced costs	Reduced costs allow improved health services across all endpoints.
Change utilization patterns (consumption)			
Product as service	Performance models in health care sector and other sectors	Direct impact on health sector via reduced costs Indirect impact for various sectors (e.g. transport) via reduced manufacturing	Reduced costs allow improved health services. Conditions related to emissions from manufacturing are reduced.
Sharing models	Product- and service-sharing platforms (business to business, business to consumer and consumer to consumer), e.g. car sharing	Indirect impact via reduced manufacturing emissions Direct impacts on air quality and noise from car sharing	Reduced respiratory and cardiovascular conditions due to lower emissions
Shift in consumption patterns	Shift to healthier diets	Direct impact on health	Reduction in poor diet related conditions, obesity, cardiovascular diseases, cancers
	Shift from material to virtual products or services	Indirect impact for various sectors via reduced manufacturing	Reduced harmful conditions related to manufacturing emissions
Combinations of actions			
Efficient use of resources, Shift in consumption, new approaches.	Healthier food production	Direct impact on health Potential for indirect health benefits from reduced GHG and other emissions from changes in food production	Reduction in poor-diet-related conditions, obesity, cancers Reduction in harmful emissions.
Efficient use of resources, sharing models, Shift in consumption	Mobility	Indirect impacts from reduced air emissions Possible impacts on road safety	Respiratory, road accident deaths and injuries
Efficient use of resources, eco design, use of renewable energy.	Built environment	Improved indoor air quality and use of nontoxic materials	Various, including occupational health and safety issues, mental ill health and respiratory conditions

	Sectors affected	Groups affected or distributional issues	Notes	Example sources
	Waste management, manufacturing	Waste sector workers, manufacturing sector workers	The literature reviewed focuses on business and environmental benefits.	Montalvo et al. (2016)
	Health	All health sector users	The health care case study (section 7) discusses the potential for sensor technology to aid replacement decisions.	EMF (2016a)
	Health, manufacturing	All health sector users	Potential for worse treatment of shared goods by users (compared to with those owned) should be taken into account in overall impact assessment.	EMF (2015c), REBus (2016b)
	General population	For car sharing, inner-city residents and low-income groups	Impact of car sharing also depends on extent of newer cars in schemes and rate of replacement.	EMF (2017a), Chen & Kockelman (2015) focus on environmental benefits.
	Agriculture, food production, consumers	Consumers Distributional issues may need further research.	See resource-efficient agricultural practices (above) and healthier food production (below)	EMF (2015b)
	Manufacturing, general population	Consumers	Broad area, for which impacts and distributional effects need further research	EMF (2016a)
	Agriculture, food production, consumers	Consumers Distributional issues may need further research.	See also resource-efficient agricultural practices above and shifts to healthier diets (above).	EMF (2015b)
	All sectors	Distributional issues may need further research.	–	EMF (2015b) gives a broad assessment of the circular economy implications for mobility.
	Commercial and residential	Potential impacts for wide range of groups	–	EMF (2015b) gives a broad assessment of the circular economy implications for the built environment.

Table 3. contd.

Process/Action	Source of potential health implications positive or negative	Health impact (direct or indirect)	Nature of potential health endpoint
Recycling, efficient use of resources, shift in consumption	Reduced use of Landfill, and incineration	Reduced direct impacts from air, water and soil pollution and GHG emissions	Reduced cancer, negative birth outcomes, and respiratory diseases
Recycling, efficient use of resources, shift in consumption	Substitution and reduced use of hazardous materials resulting in reduced need for disposal of hazardous materials in long term	Reduced direct impacts from water and soil pollution	Multiple potential impacts including on cancers, birth outcomes, and diseases of the cardiovascular and nervous systems

6.2 Findings from the review of health impacts

Some general findings from the outline of human health and welfare implications from implementation of circular economy models given in Table 3 are as follows.

The potential and known **negative health impacts** identified relate to the general category of reduced use of primary resources (production), and particularly to managing risks in the recycling and reuse of products, components and materials. These impacts are very often the unintended consequences of such actions. Specifically, the impacts refer to the management of chemicals of concern, for example, e-waste, food packaging and fire retardants in a variety of products; and to emissions from the composting of waste. Managing these risks and impacts could be interpreted as a necessary part of the transition from a linear to a circular economy, during which chemicals of concern are ideally phased out of production processes.

The recycling and reuse of products, components and materials also have many **positive implications**, for example, in the context of savings in the health care sector and through the indirect health benefits of reducing environmental impacts (air, water and soil pollution, and GHG emissions) from manufacturing and extraction processes.

The identified health implications in the other broad categories of circular economy processes – maintaining the highest value of materials and products and changing utilization patterns – are also **largely positive**. In particular, performance models of utilization show potential for significant direct health benefits for the hospital/health care sector, and a wide range of indirect health benefits can result from the implementation of resource-efficient agricultural practices, the move towards greater use of renewable energy and energy efficiency, building using circular principles and shifts to new product-sharing and product-as-service models. All these processes are expected to reduce waste generation and result in improved resource efficiency, thereby cutting environmental impacts (e.g. emissions to air, water and soil) from economic activity across a number of sectors, with a corresponding reduction in the morbidity and mortality endpoint impacts.

Table 3 also includes some examples of **packages of circular economy measures** aimed at specific sectors or issues. For example, packages for the built environment, mobility and food production

Sectors affected	Groups affected or distributional issues	Notes	Example sources
Waste management	Poorer groups live closer to landfill sites.	Evidence of health impacts from landfill is not conclusive and research continues.	WHO Regional Office for Europe (2016b) gives a literature review relevant to action on contaminated sites (WHO Regional Office for Europe, 2017a).
Waste management	Potential impacts for a wide range of groups	Long-term benefit due to reduced use of hazardous materials in production	See examples in the context of the built environment (EMF, 2015b) and contaminated sites (WHO Regional Office for Europe, 2017a).

given in the literature (EMF, 2015b, 2017a) include a variety of measures that have a range of health implications related to pollution, climate change, occupation health and public health.

Table 3 also includes the reduction of **landfill and incineration** of waste, as these are seen as a consequence of following circular economy principles and concurrent with measures to reduce use of primary resources and maintain the highest value of materials and products. It will remain necessary, however, to assess the advantages and disadvantages of options for the treatment of residual waste flows consistent with circular economy principles.

Within **SDG 12**, to ensure "sustainable consumption and production patterns"; the identified areas requiring careful management of the health implications are mainly associated with achieving the targets for environmentally sound management of chemicals and all wastes throughout their life-cycles (SDG 12.4), and the reduction of food waste (SDG 12.3). In general, however, the potential for positive health outcomes from the circular economy model should greatly contribute to achieving SDG 12, particular by achieving sustainable management and the efficient use of natural resources (SDG 12.2) and substantially reducing waste generation (SDG 12.5).

Table 3 notes the potential and known **distributional effects** for specific health impacts. Where negative impacts are identified, their effects frequently fall disproportionately on vulnerable groups, as mentioned. Impacts on waste sector workers and the population living near waste management facilities also have distributional aspects to consider, since these people are often more deprived than the general population (WHO Regional Office for Europe, 2010). The positive indirect health impacts from reduced environmental pollution (including effects of GHG and air pollution emissions beyond the vicinity of waste management facilities) are likely to benefit the poor in that such people are known to be disproportionately affected globally. Nevertheless, more detailed distributional assessment is needed for each health impact identified. Indeed, Rizos et al. (2017) found that limited information was available on the social aspects of circular economy "such as gender, skills, occupational and welfare effects, poverty and inequalities". For further discussion on distributional effects see section 4.2.

The transition to a circular economy in the WHO European Region has a **global health footprint**. As noted under distributional effects, there are direct impacts on the local population and workers in informal waste management sites to which European waste is sent for disposal and/or recycling (see the case study on e-waste). There is also a wider question of the implications of this transition in Europe, in terms of changes in production and consumption, for the health of populations in other regions of the world. For example, how will the circular economy change the quantity and type of imports into Europe and what health implications for populations in the source countries would result from changes to environmental and social impacts of resource extraction and production (FoEE, 2014)?

Much current research addresses the potential health impacts of the transition to a circular economy, for example, in the context of chemicals of concern, water reuse and e-waste. Nevertheless, this review highlights many **knowledge gaps** in the understanding of the nature of these impacts (e.g. in the case of chemicals of concern), the severity and frequency of exposures and the extent of different health endpoints, along with the environmental residence time of the pollutants causing these impacts and the latency of onset. Thus, continuing research and further evidence are essential for a more complete assessment of priorities for addressing negative impacts and enhancing positive ones. In the context of waste management, the WHO Regional Office for Europe (2016b) recommends that "in general, methods and resources for cost-efficient health surveillance should be developed", and notes that some existing evidence is becoming less relevant for some countries in the WHO European Region, as the waste industry evolves and old facilities are phased out.

6.3 Quantification and valuation of health impacts

Methodologies for quantifying and valuing health impacts are well established. Quantitative estimates of the burden of disease attributable to different factors, including the environment, can combine comparative risk assessment, exposure and epidemiological data; transmission pathways; and expert opinion, as used in the global assessment of the burden of disease from environmental risks for WHO (Prüss-Üstün et al., 2016). Economic values for health impacts and policies that address or affect them impacts can be estimated using, for example, the cost-of-illness and damage-function approaches; the latter is commonly used in the context of air pollution. This includes assessing:

- resource costs, including aversive expenditures and direct medical and non-medical costs associated with treatment;
- opportunity costs, including the costs of loss of productivity and/or leisure time; and
- disutility costs, including pain, suffering, discomfort and anxiety (Hunt et al., 2015).

6.3.1 Potential health benefits

Available estimates of health impacts from specific policies or packages of policies for the circular economy suggest very significant potential benefits across a number of sectors and for the general population. These include the following.

The first is **health externality estimates for food, mobility and the built environment**. EMF (2015b) concludes that the "circular economy scenario could have a major impact on consumers' health and related health care costs and other societal costs, capturing a significant share of the more than 3 percent of GDP lost today to obesity by 2050." Under this scenario, the Foundation estimates that annual externalities in the 27 countries belonging to the EU before July 2013 (EU27) could decline by as much as €130 billion compared with the present day, and by about €10 billion compared with the current development scenario. These externalities include CO_2 (€29/tonne) and opportunity costs (e.g. productivity loss and loss of lives) related to obesity (EMF, 2015b).

Next is **savings in the health care sector**. The implementation report on the EU action plan on the circular economy includes estimates of the impact of amendments to the Directive restricting the use of certain hazardous substances in electrical and electronic equipment. The report suggests that the overall effect of enabling secondary market operations and increasing the availability of spare parts will reduce costs for public authorities, including a saving of about €170 million after 2019 for European hospitals due to the opportunities to buy and resell used medical devices (EC, 2017b). Other evidence on performance models in procurement suggests that hospitals in Denmark could save €70–90 million by 2035, with €10–15 million in savings annually by 2020 (EMF, 2015a).

An analysis for the Ex'Tax project by Cambridge Econometrics suggests that a **shift from labour- to resource-based taxes** in the period 2016–2020 would result in not only positive GDP and employment results in the EU27 but also health benefits from lower carbon emissions and pollution levels due to reduced energy, resource and water use, as well as increased well-being from employment effects. The cumulative value added for 2016–2020 (against baseline) is estimated as: €3.1 billion in avoided costs to society due to illness and premature death from air pollution exposure,[8] €4.9 billion in avoided costs due to human and ecosystem health damage associated with pollution of land and water with toxic chemicals and metals,[9] €0.7 billion in avoided costs due to human and ecosystem health damage associated with freshwater resources, and €2.2 billion in the value of healthy years of life gained by reduced unemployment[10] (Ex'Tax et al., 2016).

The EU action plan on the circular economy estimates that the measures being taken can reduce **GHG emissions** by more than 500 million tonnes between 2015 and 2035 (EC, 2015a). The health implications of this in the long term relate to possibilities for reduced impacts of extreme weather and heat-waves.

6.3.2 Problems in translating evidence into estimates

Many studies focus on the specific risks and exposures identified in Table 3. For instance, the WHO Regional Office for Europe (2016b) outlined the existing evidence on exposures and health effects from landfill and incineration of waste. There are a number of difficulties, however, in translating the available evidence into estimates of aggregate impacts, in quantitative or monetary terms, from specific identified health issues related to the circular economy.

In general, exposure assessment methods and data to assess the quantitative relationship between waste management and health effects are limited. Spinazzè et al. (2017) highlight the persisting concerns and uncertainties about potential environmental and health effects associated with exposure to emissions from waste management facilities. They conclude that most available studies have limitations related to poor exposure assessment and limited data on direct human exposures, and that harmonized exposure assessment strategies and techniques need to be developed. Thus, they see a comprehensive characterization of human exposure to waste management emissions as a continuing challenge.

Studies that have provided evidence on the presence of chemicals of concern in recycled materials, such the DiGangi & Strakova (2015) study on BFRs in plastics products, present sample

[8] Air pollution valuation based on disability-adjusted life-years (DALYs) due to changes in exposure (Desaigues et al., 2006, 2011).

[9] Land and water pollution valuat ion based on DALYs for human health (Desaigues et al., 2011) and the value of ecosystem services gained/lost for ecosystem health (De Groot et al., 2012).

[10] Based on value of quality adjusted life years gained/lost due to changes in unemployment related mortality (Desaigues et al., 2006, 2011).

data that cannot readily be scaled up to indicate the significance of the presence at the national, European or global level, to allow aggregate estimates for specific health exposures and endpoints.

The range of approaches that have been adopted hamper comparative assessment of the order of magnitude and significance of the identified health impacts. Rizos et al. (2017) found that available studies on the circular economy often "adopt different approaches when calculating the impacts which make the comparison of results from different sources challenging".

Many scientific studies on specific health risks and exposures are not in the context of how transition to a circular economy could or has changed these risks and exposures. For example, a recent study (Trasande et al., 2015) concludes that exposure to endocrine-disrupting chemicals, including those found in plastics, in the EU contributes substantially to disease and dysfunction, causing health and economic costs exceeding €150 billion per year, but further analysis is needed to identify by how much circular economy approaches affect this, as outlined in the case study on chemicals of concern.

In addition, the Lancet commission on pollution and health included the need for research on links between pollution and health as a key recommendation. In particular, it recommends that this include: the identification and characterization of the adverse health outcomes caused by new and emerging chemical pollutants, and the improvement of estimates of the economic costs of pollution and pollution-related disease (Landrigan et al., 2017).

6.3.3 Conclusion

In conclusion, aggregate quantitative and monetized estimates for the impacts of packages of action for the circular economy are available and indicate significant potential benefits. These should be seen as order-of-magnitude indications, due to the wide range of assumptions needed for the uncertainties about the progress and extent of the transition. The quantitative evidence for specific health concerns, for example, from hazardous chemicals in recycled materials, suffers from piecemeal availability and lacks consistent exposure assessments on which to base the quantification of aggregate impacts and understanding of their relative significance.

7 Case studies

This section presents a number of case studies on health impacts of the circular economy, in order to briefly outline and discuss the pathways through which the implementation of circular economy models may affect human health and well-being. The selection is not comprehensive, but is based on key issues arising in the literature review and consultations for this report and is intended to indicate the range of possible types of positive and negative health effects.

The authors included the example of hospitals to illustrate the potential direct savings to health services from circular economy actions. The subject of chemicals of concern in waste covers a broad area for which key issues are outlined here, with related examples given for e-waste and food waste. The case study on waste-water reuse also illustrates potential health issues relevant for policy development. The examples of the built environment/mobility, climate change and air pollution are included to show the potential for much wider indirect health benefits from a circular economy model.

7.1 Health care sector

Total health expenditure accounted for about 9.9% of GDP globally and 9.5% of GDP in the WHO European Region in 2014, and the global health workforce was over 43 million, with 12.7 million in European Region in 2013 (WHO, 2011d, 2016). Thus, the sheer size of the health sector indicates the potential for considerable cost and efficiency effects from any move towards circular economy principles.

The literature identifies significant direct cost savings for hospitals and health care services from the implementation of circular economy actions (e.g. EC, 2017b; EMF 2015a). The ageing of the population, technological development and increased expectations from patients increasingly drive health care costs. In this context, there is great potential for hospitals to use their scale and centralized management to maximize resource efficiency and minimize waste through prevention and recycling. A review of evidence by the WHO Regional Office for Europe (2016a) illustrates the potential benefits of fostering environmental sustainability in health systems in Europe. In the context of waste management, it found potential financial and environmental benefits from switching to reusable medical products and enhanced treatment of hospital waste-water. The implied health benefits would come to the extent that financial savings were or could be reinvested in health care services or used to lower service charges, among other options. There are also potential indirect health benefits from these actions to the extent that they also reduce health impacts from environmental media (i.e. air, soil and water pollution and GHG emissions) resulting from manufacturing processes.

A case study on hospitals in Denmark (EMF, 2015a) highlights considerable potential savings from the adoption of two key circular economy opportunities. The first is the use of **performance**

models in procurement. Performance models involve contracts in which the customer pays for the use of a product (e.g. via leasing) rather than the product itself. This helps to minimize total costs, since ownership may involve upfront investment costs, risks (repair, maintenance or obsolescence) and end-of-use treatment costs, while performance models can reduce purchasing and maintenance costs and maximize performance. Concurrently, the supplier can secure sustainable revenue streams, maximize resource use, and drive efficiency of use. This model may also give incentives to manufacturers to design products that are easier to maintain, repair and refurbish or remanufacture. The range of products that could be procured in performance models (EMF, 2015c) includes magnetic resonance imaging (MRI) scanners, radiation treatment equipment, laboratory instruments and (semi)durable goods such as scalpels and surgical apparel. The study calculates that performance models in procurement could save hospitals in Denmark around €70–90 million by 2035, and €10–15 million by 2020.

Second, hospitals could become leaders in **recycling and waste reduction** by supporting pilot and training programmes, and creating national guidelines and/or targets. While the purchase and preparation of food and drink are significant sources of waste in hospitals, recycling rates for packaging and organic waste are well below service sector targets: averaging below 20% compared with 2018 targets of 70% for packaging and 60% for organic waste. The Health Care Without Harm Europe coalition (2018) provides examples of waste and resource savings; for example, at the University Hospital in Freiburg, Germany, the introduction of waste minimization measures resulted in total annual savings of about €321 000.

EMF (2015a) suggests where using circular principles could reduce the considerable waste generated in the health care sector, with associated cost reductions, including virtualization such as technology-driven diagnosis (e.g. various applications for the use of information and communication technologies and mobile devices for health). The Foundation's report on intelligent assets in a circular economy (EMF, 2016a) also highlights further technology-driven resource savings by making decisions on the replacement of medical equipment in hospitals using sensor technology, which reveals its actual condition, rather than the current standard of equipment age and utilization. Decision-making on the timing of replacements of existing equipment would also need to take account of the benefits of any advances that have been made in the design of newer equipment.

Another example of such potential savings comes in a proposal to amend the Restriction of Hazardous Substances (RoHS) Directive (EC, 2017b), suggesting that:

> Fully enabling secondary market operations and increasing spare part availability for certain electrical and electronic equipment will have a positive economic impact by bringing market opportunities to the repair industries and secondary selling. It will reduce costs and administrative burden both for business, including [small and medium-sized enterprises], and for public authorities. For example, it will save European hospitals[11] approximately €170 million after 2019 due to maintaining the possibility to resell and buy used medical devices (which, without the proposal, would not be possible after the transitional period).

Other examples of the development of circular economy services and projects that offer resource savings and reduce costs to health care sector include the following programmes of particular businesses.

- Phillips' refurbishing solutions for MRI systems offer savings through the reuse of components, driving value creation in the circular economy.

[11] This seems to refer to EU countries, not all countries in the European Region.

- A pilot study of the MUJO medical technology company for the REBus project (2016c) showed that service agreements were good for health. MUJO manufactures specialized equipment to aid the rehabilitation of people with musculoskeletal disorders. The project offered the equipment under a leasing arrangement (performance model), in order to reduce the production of goods required for a given size of market. The results included a tenfold reduction in the volume of manufactured material. The benefit to customers is that they no longer have to buy capital equipment.

- Other pilot studies for REBus (2016a–b) addressed the use of remanufacture in the lifts market and the resulting environmental benefits, the resource efficient use and circular procurement of furniture at University Medical Centre Utrecht, The Netherlands.

- FLOOW2 Healthcare has developed a sharing marketplace for health care organizations to trade surplus capacity; this allows more intensive use of goods and equipment, resulting in more efficient use of raw materials and energy.

In addition, potentially significant indirect savings in health care costs could result if the implementation of circular economy models reduces the overall burden of disease by reducing pollution from production and consumption. The Lancet commission report on pollution and health highlights that pollution-related disease results in health care costs equivalent to about 1.7% of annual health spending in high-income countries and up to 7% in middle-income countries that are heavily polluted and rapidly developing (Landrigan et al., 2017). On the other hand, additional health care costs could result from a failure adequately to address potential health risks, for example, from chemicals of concern in recycling and reuse. The WHO Regional Office for Europe (2017c) strategic document on environmentally sustainable health systems builds on the evidence of the potential benefits of a circular approach outlined above, to propose types of actions that embed circular economy principles. These include: minimizing and adequately managing waste and hazardous chemicals; promoting an efficient management of resources; promoting sustainable procurement; and reducing health systems' emissions of GHGs and air pollution.

7.2 Chemicals of concern in products

The growth in the number and volume of new chemicals produced over recent decades provides the wider context for the existence of chemicals of concern in products. The report of the Lancet commission on pollution and health (Landrigan et al., 2017) states that over 140 000 new chemicals and pesticides have been synthesized since 1950 and that the 5000 produced in the greatest quantities have become widely dispersed in the environment, with associated widespread human exposure. Less than half of these have been tested for safety or toxicity, while rigorous evaluation of new chemicals before they are put on the market has occurred only in a few high-income countries. This has resulted in limited knowledge of the nature and extent of their effects on health and the environment, although some evidence has been emerged in recent years. Consequently, Landrigan et al. (2017) conclude that the contribution of chemical pollution to the global burden of disease is almost certainly underestimated.

In principle, the circular economy should entail the avoidance or phasing out of specific materials such as toxic substances, where these damage human health or the environment or where recycling or reuse is more technically complex and expensive, unless there is a compelling socioeconomic case for continued use, such as that applied in the REACH Regulation. In reality, however, hazardous chemicals can cause problems in the implementation of circular economy processes, especially in recycling, reuse and remanufacturing, owing to:

- long-lasting products containing chemicals that have been banned;

- the contamination of feedstock in production processes, as it is more difficult to control feedstock quality for recycled material than virgin material;
- the presence of chemicals whose use in manufacturing within the EU is illegal but not restricted in imported articles; and
- insufficient understanding of the toxicity of many chemicals that may be still in use (CHEM Trust 2015).

The EU action plan explicitly recognizes the issue of chemical substances that are identified as being of concern for health or the environment and may be not only present in recycling streams but also costly to detect and remove. It is thus committed to "the promotion of non-toxic material cycles and better tracking of chemicals of concern in products to facilitate recycling and improve the uptake of secondary raw materials" and the assessment of legislation on waste, products and chemicals in the context of a circular economy to address the presence of substances of concern and facilitate their traceability and risk management in the recycling process (EC, 2015b). At present the EC has noted that the lack of sufficient information about substances of concern in products, waste streams and recycled materials hampers the monitoring of the compliance of recycled materials (and articles produced with them) with legislative requirements (including the REACH Regulation, the classification, labelling and packaging (CLP) Regulation and the RoHS Directive). The EC also notes both the lack of a general framework to deal with the presence of substances of concern in recycled materials and difficulties in applying EU waste classification methodologies to the recyclability of materials. It is therefore developing analysis and proposed options on these issues that will feed into a future EU strategy for a nontoxic environment (EC, 2017a).

In general, circulating any products, components and materials that may be included as substances of very high concern (SVHCs) and subject to authorization under the REACH Regulation has health implications to be assessed. REACH Article 57 defines SVHCs as substances that have hazards with serious consequences, including those classified as carcinogenic, mutagenic or toxic for reproduction (category 1A or 1B). Listing a substance as one of the SVHCs by the European Chemicals Agency (ECHA) is the first step in the procedure for restriction of its use. The most recent list, from January 2018, included 181 SVHCs (ECHA, 2018a).

Three examples of chemicals of concern of relevance to circular economy processes (especially recycling, reuse and remanufacturing) and arising in current research and policy development are BPA, BFRs and polyvinyl chloride (PVC).

- BPA is used in polycarbonate plastics, food can linings and thermal paper (e.g. till receipts) and card (e.g. pizza boxes). It was listed in the candidate list of SVHCs in June 2017 owing to its endocrine-disrupting properties. Endocrine-disrupting chemicals are suspected of altering reproductive function; increasing the incidence of breast cancer, abnormal growth patterns and neurodevelopmental delays in children; and changes in immune function (UNEP & WHO, 2012). The ECHA Risk Assessment Committee concluded that the risk from BPA in till receipts is not "adequately controlled" (CHEM Trust, 2015). Trasande et al. (2015) concluded that exposure to endocrine-disrupting chemicals in the EU contributes substantially to health impacts, with health and economic cost estimates exceeding €150 billion per year, although the proportion associated with recycling is not assessed (EMF, 2016b). BPA was recently banned in thermal paper in the EU from 2020 under the REACH Regulation, classified as toxic for human reproduction (category 1B) under the CLP Regulation, restricted in materials in contact with food (such as infant feeding bottles) and limited in toys, with a current migration limit of 0.1 mg/l[12] and a proposal to lower the limit to 0.04 mg/l in 2018.

- BFRs are widely used in products including furniture, electronics and building products. The long life of these products increases their potential to contain banned chemicals by the time they enter the waste stream. Many flame-retardant chemicals have been identified as substances of concern for effects such us mutagenicity, endocrine disruption and carcinogenicity. In some products, such as furniture, people can be exposed to BFRs through not only direct contact but also dust released though use; there is particular risk to children, manufacturing workers and fire-fighters.[13] Some evidence has been found of BFRs in toys (Chen et al., 2009).

- PVC is a concern for recycling due to the presence of the softener diethylhexyl phthalate (DEHP) in some items such as footwear and floor coverings. This poses a reproductive toxicity threat to exposed workers. While the REACH Regulation bans DEHP, debate continues on EC proposals to authorize the recycling of plastics containing DEHP in new PVC products.[14]

The case studies on e-waste and food give other examples of chemicals of concern in products. In general, this is an area of scientific uncertainty that is undergoing extensive research. The difficulty of assessing complex long-term exposure and compounding effects further complicates the evidence on the health implications.

[12] European standards require that 10 cm² of material from a toy be extracted with 100 ml of water for one hour. Compliance with the specific limit value of 0.1 mg/l thus means that, during the extraction, a maximum of 0.01 mg BPA may migrate out of the toy material.
[13] HEAL (2016a) has made a case for flame-retardant-free furniture.
[14] Both the European Parliament (2015) and Breast Cancer UK (2016), for example, contributed to this debate.

7.3 E-waste

E-waste refers to all items of electrical or electronic equipment and its components that have been discarded without the intent of reuse (STEP Initiative, 2014). Global e-waste generation was estimated to be about 44.7 million tonnes in 2016, a figure forecast to increase to about 50.7 million tonnes by 2020. Europe (including the Russian Federation) generated the second largest quantity of e-waste on a per capita basis (16.6 kg per inhabitant) after Oceania (17. kg per inhabitant) in 2016 (Baldé et al., 2017).

The estimated economic value of raw materials contained in the estimated e-waste generated in 2016 is about €55 billion, which demonstrates the business potential of adopting circular business models. Although e-waste has high potential for recovery of precious metals, valuable materials, rare earths and plastics, with resulting economic benefits, official take-back systems are documented to collect and recycle only 20% of global e-waste. Europe has the highest rates of e-waste collection for recycling, including from households, business and institutions: around 35% in 2016. Countries in northern Europe performed better; their rate of 49% is the highest in the world. Other high-income regions, such as North America and Oceania, collect only 22% and 6%, respectively, of e-waste generated (Balde et al., 2017).

The fate of a large majority of global e-waste (34.1 tonnes in 2016) is unknown. In countries where a waste management system does not exist or is not yet well developed, e-waste is usually dumped, incinerated, traded or recycled under inferior conditions. In countries with e-waste policies and legislation and a well established infrastructure, however, the e-waste that is not reported as collected and recycled by the official take-back systems often ends up in residual or household waste. Much is also handled by metal recycling companies and waste traders, or shipped to economies in transition or developing countries, usually classified as second-hand items for reuse.

A key issue here is that a substantial portion is not reusable, and many developing countries lack adequate policies and legislation to set up the necessary infrastructure to manage e-waste in an environmentally sound way, so handling and disposal are frequently unregulated. A study conducted in 2015/2016 showed that EU Member States originated around 77% of used electric and electronic equipment imported into Nigeria, and China and the United States contributed 7.3% each (Balde et al., 2017). The Agbogbloshie area of Ghana has one of the largest informal e-waste dumping and processing sites in Africa, with about 215 000 tons of e-waste imported annually (Heacock, 2016).

Improper and unsafe treatment and disposal of the e-waste pose significant challenges to the environment and human health. Discarded equipment – such as refrigerators, telephones, laptops, washing machines, sensors, televisions and lamps – contain hazardous substances such as heavy metals (e.g. mercury, lead, cadmium, etc.) and chemicals (e.g. chlorofluorocarbons (CFCs) and various flame retardants). Improperly landfilled or incinerated e-waste poses significant contamination problems. In many developing countries, landfills leach toxins into groundwater and incineration is performed in unsafe ways that emit toxics, including dioxins. The hazardous materials contained in e-waste are volatile and not biologically biodegradable; through leaking, chemical reactions and vaporization, they contaminate soil and groundwater and can enter the food chain. Heavy metals are toxic to plants, animals and microorganisms. In humans, heavy metals can affect the organs, especially the brain, causing persistent effects on the nervous system. Chemicals such as some flame retardants can form corrosive or toxic fire gases and toxic decomposition products when burned. Releases of CFCs in the environment affect the human central nervous system and contribute greatly to the reduction of the planet's protective ozone layer.

E-waste can therefore contribute to adverse health effects through many possible routes. Health effects relate especially to the exposure of people working and living near informal e-waste processing sites via the contamination of air, soil, water and food, but may also affect populations away from these sites. Grant et al. (2013) concluded that the health consequences of e-waste exposure may include changes in thyroid function, altered cellular expression and function, adverse neonatal outcomes, cognitive and behavioural changes, and decreased lung function. Further, there are increased potential impacts for children, for whom exposure from contaminated food and dust, for example, may cause a high risk in neurotoxicity and adverse developmental effects (Zheng et al. 2013). In addition, recycling activities, such as dismantling electrical equipment, has the potential for increased risk of injury.

In addition, some studies suggest that evidence of hazardous materials in some products may be linked to recycled e-waste. For example, the survey by DiGangi & Strakova (2015) found that children's toys in six EU Member States contained octabromodiphenyl ether and decabromodiphenyl ether, which are used in plastics for electronics. Samsonek & Puype (2013) found flame retardants in plastic materials, such as thermo cups and kitchen utensils. Further research is needed to establish the source of these materials in products. Such substances are among those listed in the Stockholm Convention on Persistent Organic Pollutants that should not be present in children's products, consumer products, food contact materials, and other products. For example, the Persistent Organic Pollutants Review Committee has agreed that decabromodiphenyl ether is likely to lead to significant adverse effects on health and the environment.

A number of international initiatives are addressing global e-waste issues. WHO is working to identify the main sources and potential health risks of e-waste exposures, and to define successful interventions with support from the United States Environmental Protection Agency, the United States' National Institute of Environmental Health Sciences and the German Federal Ministry for

the Environment, Nature Conservation and Nuclear Safety. It has also launched the Initiative on E-waste and Child Health. The Solving the E-Waste Problem (STEP) Initiative (2014) aims to reduce dangers to human beings and the environment from inadequate treatment practices.
E-waste is subject to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, which bans the shipments of hazardous waste between developed and developing countries. Compliance is difficult to monitor, however, because reliable data are not available on the amount of exported electrical or electronic equipment that is accurately classified as e-waste (Heacock et al., 2016). Moreover, some commentators argue that current international law does not foster accountability over transboundary flows of e-waste and thus limits the potential to address impacts on vulnerable populations (Khan, 2016).

Key legislation in the EU of relevance to e-waste includes (Lundgren 2012):

- the Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC), which is intended to prevent e-waste generation, and to promote reuse, recycling and other forms of recovery and the improvement of the environmental performance in the life-cycle of this equipment;

- Regulation (EC) No. 1013/2006 on shipments of waste, which includes guidance on shipments of waste electrical and electronic equipment;

- the RoHS Directive (2002/95/EC and revised 2011/65/EU), which aims to contribute to the protection of human health and the environmentally sound recovery and disposal of e-waste;

- the REACH Regulation, which entered into force in 2007, to ensure a high level of protection of human health and the environment from the risks posed by chemicals;

- the EU Waste Framework Directive (2008/98/EC), which provides the legislative framework for the collection, transport, recovery and disposal of waste.

In the long run, adopting circular economy models should promote greatly reduced environmental and health impacts from e-waste. This can be achieved by substantially increased reuse and remanufacturing; these will reduce the proportion of devices reaching the ends of their useful lives that need to have their components recycled.
To this end the report on the implementation of the EU action plan on the circular economy includes proposals to amend the RoHS Directive in order to prolong the use of electrical and electronic equipment and postpone its end-of-life and disposal, thus avoiding the generation of additional hazardous waste (EC, 2017b).

Circular economy models also need to be adopted to recover the precious metals, including gold, silver, copper, platinum and palladium, contained in e-waste, and to recycle valuable bulky materials, such as iron and aluminium, along with plastics. In addition, the materials currently used – including hazardous compounds such as mercury lamps in liquid crystal display screens, PVC, flame retardants and other toxic additives in plastic components – and the design of electric and electronic equipment make recycling and reuse challenging. Circular solutions should therefore include the optimized design of electric and electronic equipment, to enable its disassembly, the reuse of components, the recovery of valuable and precious materials and the designing out of hazardous components. For example, the new generation of light-emitting diode screens is nonhazardous and easier to dismantle with automated systems (Hislop & Hill, 2011). Nevertheless, the existing environmental and health hazards associated with exports of e-waste to developing countries with inadequate and unsafe waste facilities still needs to be urgently addressed, while circular solutions are being developed (Benton et al., 2015).

7.4 Food safety and healthy foods

Health impacts from the circular economy model include both direct food safety issues and potential benefits related to healthy foods, from food waste policies and practices and, indirectly, from enabling healthier food choices.

7.4.1 Food safety

Significant household savings are envisaged for reducing the level of food waste. Reducing food waste in Denmark from 80–90 kg per capita to 40–50 kg per capita, for example, is estimated to enable households and businesses to save €150–200 million annually by 2035 (EMF, 2015a). The application of circular economy principles via adherence to the food waste hierarchy – with priority given to (in descending order) reducing waste, redistributing edible food, using food as animal feed, composting and anaerobic digestion, and finally disposal – should also entail health benefits if appropriate health and safety standards are respected (FoEE, 2014). For example, redistributing edible food to people in need and vulnerable groups should have positive health effects, given adherence to appropriate safeguards against contamination and the distribution of unhealthy foods, and there will be environmental health benefits to the extent that environmental impacts from food production and processing are reduced from current levels.

Nevertheless, finding chemicals of concern in recycled materials used in food packaging and kitchen items has raised some issues of food safety (see, for example HEAL, 2016b). Examples include the detection of chemicals such as BPA, phthalates and perfluorocarbons in recycled materials in pizza boxes in Denmark (Søndergaard, 2015) and e-waste recycled into plastic materials used in kitchen utensils, as mentioned above (Samsonek & Puype, 2013). The styrene monomer has been found in food packaging in the United States (Genualdi et al., 2014). There is also evidence of phthalates (suspected to be an endocrine-disrupting chemical) in packaging (EMF, 2016b; Rodgers et al., 2014; Rudel et al., 2011). The contamination of compost with harmful packaging or packaging components is a further issue of concern. Such components, such as heavy metals at high concentrations, could not only reduce compost quality but also allow these substances to enter the food chain and pose a risk to human health (EMF, 2016b; Lopes et al., 2011).

Even though research focuses on concerns about food contamination, information is not generally available on the extent of any health impacts. Potential types of impacts from BPA and phthalates include endocrine disruption and carcinogenicity, as described above.

The EU action plan on the circular economy acknowledges the issue of food safety in policy actions on food waste with a commitment "to clarify EU legislation relating to waste, food and feed and facilitate food donation and the use of former foodstuff and by-products from the food chain in feed production without compromising food and feed safety" (EC, 2015b). Moreover, the EU Platform on Food Losses and Food Waste (EC, 2018a) has a mission to support the achievement of the targets of SDG 12.3 (halving per capita food waste at retail and consumer level, and reducing food losses along the food production and supply chains by 2030) without compromising food safety, feed safety and/or animal health. A current policy concern is that the regulation of chemicals in food contact materials in the EU is not harmonized. While there are controls on the use of recovered plastics in food contact materials, there are no such requirements for other materials used, such as paperboard, ink and glue. Thus, while EU law requires the recycling of packaging, it does not address the chemical content in a consistent way (CHEM Trust, 2015).

7.4.2 Healthy foods

The literature also proposes that the implementation of the circular economy can promote the production and consumption of healthier foods. The report of a case study on the food system made by EMF (2015b) presents a circular economy vision that would address current issues of food waste, environmental externalities (e.g. in fertilizer use and GHG emissions from the food production chain) and unhealthy outcomes for consumers; it gives examples of digital solutions, such as smart refrigerators, on demand e-commerce delivery and wearable monitors.

This vision would (EMF, 2015b):

> restore and rehabilitate land and fish stocks and would reconnect nutrient and material loops to provide the needed input. The system would leverage digital solutions and greater proximity to consumers to avoid waste along the value chain. The distributed food would be non-toxic and healthy.

This would be achieved by the implementation of:

- resource-efficient agricultural practices, including reductions in fertilizer and pesticide use;
- regenerative farming practices to preserve natural capital and optimize long-term yields, including organic cultivation; and
- closed loops of nutrients and other materials: recovery of energy and nutrients from waste streams.

The literature on the circular economy and food production focuses primarily on these resource efficiency and environmental benefits, including from a switch away from meat production (e.g. Rabobank, 2014). A review of evidence on changes in GHG emissions, land use and water use resulting from shifting current western diets towards more sustainable dietary patterns (Aleksandrowicz et al. 2016) outlines the potential environmental benefits. Further, circular approaches are also seen as giving consumers greater ready access to fresh, high-quality food that would encourage healthier dietary choices. For example, a report for the Rockefeller Foundation–Lancet commission on planetary health (Whitmee et al., 2015) notes that benefits to health from a movement towards a circular economy include those resulting from changes in diet. Nevertheless, this requires continued raising of consumers' awareness of these issues; for example, a report (EC, 2014a) includes a case study on food waste that recommends actions to educate consumers on the negative health and environmental impacts of unsustainable food consumption.

This vision could be seen as not exclusively the result of implementing the circular economy concept but also interlinked with the wider agenda of the green economy and sustainable development. It nevertheless illustrates the potentially very significant health benefits that could be achieved, for example, in terms of decreased overweight and obese populations, to the extent that the circular economy model changes food demand patterns towards healthier choices. The McKinsey Global Institute (2014) estimated that overweight and obesity have a societal cost of 3.3% of European GDP.[15] The report of EMF (2015b) estimates a decline in negative externalities under a circular economy scenario of up to €130 billion by 2030 (as given in section 6), which includes opportunity costs (e.g. loss of productivity and lives) related to obesity.

7.5 Waste water reuse

This section summarizes the rationale, policy context and health implications of waste-water reuse in Europe, with a focus on the EU, as well as examples taken from other countries in the WHO European Region. The uses of recycled waste-water covered here include irrigation in agriculture, industry and aquifer recharge. Water reuse also includes direct and indirect potable reuse (WHO, 2017c). The section also briefly covers the use of sewage sludge as an agricultural fertilizer.

[15] This estimate of societal cost includes: (i) productivity losses using DALYs lost attributable to high body mass index; (ii) direct health care costs from WHO estimates; and (iii) investment in mitigating obesity via analysis of the research budgets in prevention programmes, and commercial weight management markets.

7.5.1 Rationale

A key rationale for reusing treated waste-water is to address the pressures of competing water demands, including for irrigated agriculture, industry, tourism and domestic uses. While waste-water reuse is already being widely practised in some parts of the WHO European Region, its significance is likely to grow in the context of the increasing severity of water scarcity and droughts due to climate change and increasing populations. Water reuse can also have other environment benefits, from relieving the pressure of discharges from urban waste-water treatment plants to sensitive areas and requiring less energy than alternative sources of water supply, such as desalination or water transfer.

As the pressures of urbanization, the demand for food and the scarcity of water increase, reusing sanitation waste is becoming more attractive and viable. Many authorities and enterprises are working on models of sanitation service chains that make beneficial use of nutrients, water and energy and offset the cost of service provision. These models can offer health benefits by removing excreta from the environment and increasing food production (WHO, 2016c).

7.5.2 Policy context

Treated waste-water reuse is widely acknowledged as an alternative source of water supply at the international, European and national levels. SDG 6, on ensuring access to water and sanitation for all, includes a target for a substantial increase in recycling and safe reuse of waste-water globally by 2030. Safe reuse is also a priority in the Declaration of the Sixth Ministerial Conference on Environment and Health (WHO Regional Office for Europe, 2017b), the strategic implementation plan of the European Innovation Partnership on Water (2012) and the Blueprint to Safeguard Europe's Water Resources (EC, 2018d).

In the EU, approximately 1 billion m^3 of treated urban waste-water is reused annually, but the potential figure is estimated to be around six times as large (BIO by Deloitte et al., 2015). The practice of waste-water reuse varies widely among the other countries in the WHO European Region. Some, such as Israel are leaders, in this field (TheTower.org Staff, 2016), while there is also much unplanned and informal reuse in other parts of the Region: for example, for irrigation in central Asia (Frenken, 2013). In Turkey, untreated waste-water reuse in agriculture has historically involved informal practices, although new urban waste-water treatment plants are enabling greater planned reuse in agriculture (Arslan-Alaton et al. 2011).

Existing regulations and standards on waste-water reuse include international guidelines, such as the WHO guidelines for the safe use of waste-water, excreta and greywater, International Organization for Standardization (ISO) standards, and EU and national regulations. (WHO, 2006; ISO, 2015; EC, 2016a, 2018d). To assist in the implementation of its guidelines, WHO promotes and recommends sanitation safety plans (SSPs), which use a step-by-step risk-based approach to systematically identify and manage health risks along the whole sanitation chain, including safe disposal and reuse of waste-water, to ensure the system is managed to meet health objectives (WHO, 2016b). The Ostrava Declaration suggests that policies and regulations use the SSP approach to systematically manage health risks (WHO Regional Office for Europe, 2017b).

In the EU, a number of guidelines and regulations relate to water reuse, including the Guidelines on integrating water reuse into water planning and management in the context of the Water Framework Directive (EC, 2016b) and the Urban Waste Water Treatment Directive. The EU has no common environmental or health standards for water reuse, although some countries within and outside it have defined standards. For example, Spain has implemented regulatory standards on quality of water in contact with food (BIO by Deloitte et al., 2015).

The use of treated sewage sludge as an agricultural fertilizer is subject to EU and national guidance and regulation. The Sewage Sludge Directive (86/278/EEC) seeks to encourage the use of treated sewage sludge in agriculture and to regulate its use to prevent harmful effects on the environment and health. This includes setting limit values for a number of heavy metals. As part of the EU circular economy package, the EC (2016a) has proposed a regulation that would significantly ease the access of organic and waste-based fertilizers to the EU single market; this would provide significant market opportunities for organic fertilizer products, including sewage sludge. The EC (2015a) circular economy package commits to a number of actions to promote the uptake of water reuse, including for better integration in water planning management, legislation on minimum quality requirements for water reuse in irrigation and aquifer recharge, industrial water reuse, support for research and innovation, and prioritization of investment.

Countries outside the EU vary widely in policies related to water reuse. For example, the review by Spinoza (2011) concluded that eastern Europe showed a great diversity in practices and legislation on sewage sludge management. For central Asian countries, a review of water-related health problems (Bekturganov et al., 2016) identified a lack of regulations to protect the environment and public health as a key factor affecting the spread of water-related diseases (Frenken, 2013). In Turkey, the policy aim is approximation of EU regulations on water reuse (Yaman, 2012), although Maryam & Büyükgüngör (2017) concluded that the lack of policies and laws is a main hurdle to waste-water reuse.

7.5.3 Health risks

Direct or indirect exposure to microbiological agents (viruses, bacteria, parasites and helminths) or chemical substances that may be present in reclaimed water can create risks to public and occupational health related to waste-water reuse (Amec Foster Wheeler Environment & Infrastructure UK Ltd et al., 2016). Possible exposure pathways include direct ingestion, dermal exposure and inhalation of contaminants in treated waste-water, as well as ingestion of microbiological and chemical hazards in food crops or fodder-fed animals.

Possible risks to human health from eating or contact with food irrigated with waste-water include exposure to pathogens (e.g. *Salmonella*, *Escherichia coli*), viruses (e.g. hepatitis A), parasites (e.g. *Cryptosporiduim*), potentially toxic contaminants and persistent organic contaminants (e.g. polychlorinated biphenyls – PCBs) (Amec Foster Wheeler Environment & Infrastructure UK Ltd et al., 2016). Inappropriate reuse practices may also contaminate surface and groundwater sources that are used for the production of drinking-water.

There is also a possible linkage between use of waste-water and the spread of antimicrobial agents in the environment. There is evidence of human risks associated with exposure to bacteria with antimicrobial resistance (AMR) and their AMR genes in environmental media via routes including water, waste-water and irrigated produce (WHO, 2014).

Health effects from reuse depend on the origin of waste-water, level and nature of treatment, and subsequent use (BIO by Deloitte et al., 2015). Salgot et al. (2006) and WHO (2006) further outlined the risks to human health and the environment associated with reclaimed water reuse. In addition, the reuse of treated waste-water may have beneficial environmental health effects to the extent that it reduces secondary effluent discharges to the environment (Amec Foster Wheeler Environment & Infrastructure UK Ltd et al., 2016).

Health risks associated with use of sewage sludge in agriculture concern the presence of viruses, bacteria, protozoa and helminths. The level of these risks depends on a number of factors, including how the sludge is treated and how it is used on the soil (and the effectiveness of risk management in these processes), and the type and uses of the crop concerned. For example, a number of countries in central Asia, the Caucasus and the Balkan area register soil-transmitted helminth infections due to poor sanitation and waste-water management. A study by Risk & Policy Analysts Ltd et al. (2008) found that "significant environment or health risks linked to the use of sewage sludge on land in the EU have not been widely demonstrated by observations or risk assessments in scientific literature since the directive has taken effect". Nevertheless, the EC is assessing whether the current Sewage Sludge Directive should be reviewed, including gathering further information are the presence of emerging pollutants in sewage sludge (EC, 2018c).

7.5.4 Research

A number of EU-funded research projects relate to water reuse, such as those on integrated concepts for reuse of upgraded waste-water (2002–2006) and the Innovation & Demonstration for a Competitive and Innovative European Water Reuse Sector project, to promote a wider understanding and awareness of water reuse practices among public administrations and end-users. Those with a specific focus on health risks include the project on safe food production using low-quality waters and improved irrigation systems and management. Its results included the finding that there were minimal microbiological health risks from eating tomatoes or potatoes irrigated with recycled water (SAFIR, 2009). Some studies have reviewed and compared levels of bacteria (e.g. *E. coli*) in products irrigated with treated waste-water and conventional irrigation water. For example, Forslund et al. (2013) found that tomatoes irrigated with treated waste-water (using membrane bioreactor technology and gravel filters) were free from *E. coli*.

The results cited above illustrate a general lack of current evidence for human health effects from water reuse in the EU. For example, Amec Foster Wheeler Environment & Infrastructure UK Ltd et al. (2016) note that the available literature "does not report cases of human diseases caused by reclaimed water in the EU". Further, the EC initiative for minimum quality requirements for reused water in the EU states that (EC, 2016d):

> The establishment of EU minimum quality requirements on water reuse is expected to have positive impacts on health and welfare as minimizing the risk of contamination with insufficiently treated reused water. This impact is however expected to be limited as no evidence has been found that current practices in the EU are causing health issues.

There is, however, a recognized need for more research in this area. The problem tree for optimizing water reuse in the EU, given by BIO by Deloitte et al. (2015), identifies "lack of information about actual risks" among informational needs. In particular, Amec Foster Wheeler Environment & Infrastructure UK Ltd et al. (2016) concluded that "there are very few health risk quantification studies and epidemiological studies on the reuse of reclaimed water".

In countries in the WHO European Region that do not belong to the EU, research on health impacts is more limited but shows different outcomes from EU-based research in some areas. For example, a review of water-related health problems in central Asia identified major factors affecting the spread of water-related diseases, including the use of untreated waste-water to meet water shortages, as well as a lack of infrastructure for waste-water treatment and discharge, of health awareness and proper handling of polluted water, and of regulations (Bekturganov et al., 2016; Frenken, 2013).

Current research challenges and uncertainties on waste-water reuse include the presence and impacts of "contaminants of emerging concern" (BIO by Deloitte et al., 2015). This covers a wide range of compounds, such as residues from pharmaceutical products, personal care products, pesticides and industrial chemicals, for which there is limited monitoring in conventional waste-water treatment systems. Specific areas of uncertainty and continuing research include the lack of comprehensive toxicological data on their potential impacts on human health and the environment. The Joint Research Centre published a watch list of emerging or little-known pollutants across the EU (Carvalho et al., 2015).

Differences between public health and occupational health risks from exposure to reclaimed water are also an area of uncertainty. Although agricultural and industrial workers involved in activities in which reclaimed water is used may face greater exposure to potential contaminants over longer periods than the public, they may also have a greater awareness of and implement risk control measures in these activities (BIO by Deloitte et al., 2015).

7.5.5 Conclusions

While there is no clear evidence that current practices in the EU for both reusing treated water and using sewage sludge in agriculture are affecting human health, the need for more research in this area is recognized, particularly the need to reduce uncertainties about the presence of pathogens and chemical pollutants of emerging concern. Further research in this area is particularly important in supporting the development of appropriate standards related to health and to inform public acceptance of water reuse; in particular, BIO by Deloitte et al. (2015) cite lack of public acceptance as a key reason for the current limited uptake of water reuse options in the EU.

Other countries in the WHO European Region vary much more in the policy context related to waste-water reuse; some have limited regulation, poor sanitation and waste-water management, and greater informal waste-water reuse. While more research is needed on the health impacts of water reuse practices in these countries, the need for further implementation of improved waste-water reuse management to address health risks is in general much greater than in EU countries.

7.6 Built environment

The literature on the circular economy includes broad visions of how the further introduction of circular principles into design, construction and urban planning could greatly improve the built environment over coming decades (e.g. ARUP, 2016; Cheshire, 2016; EMF, 2015b, 2017a). This case study outlines the key aspects of such visions, based largely on the work of EMF in this area, and discusses the types of health implications arising from such visions. The broad scope of the scenarios for urban development envisaged in the literature are interlinked with and play a key part in achieving the wider goals of smart cities, the green economy and sustainable development.

Growth within: a circular economy vision for a competitive Europe (EMF, 2015b) identifies four factors that account for the current structural waste in the built environment, summarized as: low productivity in construction; underutilization of some buildings (even though there is also over-utilization of some buildings and 11 million EU households (5%) live conditions defined as overcrowded or substandard); high energy consumption; and end-of-life waste and toxic materials. Much of the end-of-life waste is hard to separate, and contains toxic elements such as PVC (see case study above) and volatile organic compounds, some of which are suspected carcinogens and immune system disruptors.

The report (EMF, 2015b) then outlines six types of actions that could advance the built environment towards a less wasteful model based on circular principles:

1. moving construction towards factory-based industrial processes and three-dimensional printing, including use of renewable or recyclable and non-toxic materials;
2. better energy efficiency and distributed production of renewable energy: buildings becoming producers of energy for example in form of solar photovoltaic systems;
3. shared residential space, such as shared drying rooms and social areas;
4. shared office space and virtualization;
5. modularity and durability: greater flexibility in building and room configurations, such as via standardized interior components; and
6. urban planning such as promoting compact urban growth.

A development scenario based on these actions, with urban planning as a core element, is proposed that would create a circular built environment that would "lower household costs; protect land from degradation, fragmentation, and unsustainable use; reduce negative environmental impact; and make cities more liveable and convenient" (EMF, 2015b).

Minimizing negative externalities is a core aim of implementing circular principles in the built environment, including impacts on climate change, water, soil, noise and air pollution and implications for human health and well-being (ARUP, 2016). Although the sources reviewed do not assess or quantify in detail the health implications arising from their circular building visions, the main potential types of impact can be categorized as:

- health benefits from the use of non-toxic materials in new buildings and phasing out of toxic materials;
- improved air quality from, for example, reduced traffic congestion and expanded green infrastructure;
- health benefits associated with reduced GHG emissions (see case study on climate change) due to progress on energy efficiency and distributed production of renewable energy (the circular scenario described by EMF (2015b) projects that, by 2050, "neutral or positive energy buildings" could reduce CO_2 emissions by as much as 85% compared to current buildings in the EU27); and
- increasing well-being resulting from improvements in the quality of the urban environment due to the improving quality of public, work and residential areas and their buildings, and expanding green infrastructure (societal outcomes are described in terms of enhanced liveability including reduced noise).

Further research is needed to more fully explore the nature and extent of potential health benefits from the application of circular principles in the built environment. The contribution of circular economy principles to wider urban health goals, as measured by health indicators of sustainable cities (such as those for urban air quality and premature mortality from cardiorespiratory disease given by WHO (2012)), could then be more clearly assessed.

Networks such as the University College London (2018) Circular cities research hub and EMF (2018) Circular Cities Network are moving circular building design and construction forward. Arup, The Built Environment Trust and other partners have developed building prototypes made from reusable components, to demonstrate how circular economy principles can be applied to the built environment. In addition, a number of European cities, such as Peterborough, United Kingdom (Future of Peterborough, 2018) and Amsterdam, Netherlands, have embraced the circular city concept (see Annex 4).

7.7 Climate change

This section provides a brief overview of the health implications related to climate change mitigation resulting from a transition to a circular economy. The overall health effects of climate change have been assessed as largely negative and include:

- extreme heat contributing to the incidence of cardiovascular and respiratory diseases (including asthma);
- increased weather-related natural disasters and variable rainfall patterns, directly causing deaths and physical injuries, and increased risks of diarrhoeal and water-borne diseases; and
- changes to patterns of infection with diseases such as malaria.

Although there may also be some localized health benefits, such as decreased winter deaths in temperate climates, WHO (2017a) concludes that, even without taking account of all possible health impacts, climate change may cause almost a quarter of a million additional deaths per year between 2030 and 2050: 38 000 from heat exposure in elderly people, 48 000 from diarrhoea, 60 000 from malaria and 95 000 from childhood under nutrition. Thus, wide-ranging strategies and actions that successfully mitigate climate change by reducing GHG emissions could have significant future health benefits by preventing morbidity and mortality.

The circular economy is seen as a significant step towards a low-carbon, resource-efficient economy and therefore a key contribution to climate change mitigation (HEAL, 2015, Wijkman & Skånberg, 2015). The EU action plan (EC, 2015b) explicitly links action on the circular economy to other key priorities, including climate and energy. For example, the EC waste package (EC, 2014a) was estimated to have the potential to reduce GHG emissions by 443 million tonnes between 2014 and 2030.

Types of circular economy action that have potential to mitigate climate change that are identified in this report (see Table 3) include:

- the use of recycled materials in manufacturing processes that can foster overall energy savings and lower GHG emissions, depending on the recycled material and energy mix;
- the move towards more efficient use of resources in industrial sectors and agriculture resulting in reductions in GHG emissions; and
- the move towards renewable energy and energy efficiency across many sectors.

For example, progress on energy efficiency and the distributed production of renewable energy is expected to reduce GHG emissions in the built environment (see the previous case study). The circular scenario described by EMF (2015b) projects that, by 2050, "neutral or positive energy buildings" could reduce CO_2 emissions by as much as 85% in the EU27.

More research is needed to more fully identify and quantify the range of potential health effects resulting from circular economy actions that cut GHG emissions. An estimate of averted health impacts due to extreme heat was made for this report based on the estimate of a reduction of 500 million tonnes in GHG emissions during the period 2015–2035 due to circular economy actions, as given by the EC (2015a). These reductions would result directly from cuts in emissions from landfills and indirectly from recycling of materials, which therefore reduces resource extraction and processing emissions. The resulting averted heat-related mortality in EU Member States is estimated at 70 deaths, with a potential range of 20–130 deaths, and an economic benefit, with no discounting, of about US$ 150 million, or in a range of US$ 100–250 million (J. Spadaro, Researcher, Environmental Sciences, Bilbao, Spain, personal communication, August 2017).

While great uncertainties are attached to such quantitative and monetary estimates of the health benefits of climate change mitigation measures, these benefits are potentially significant for programmes of action related to the transition to a circular economy. In addition, benefits from reduced GHG emissions in Europe would also spread beyond its borders; in particular, as mentioned, such health benefits are likely to be especially felt by vulnerable groups that are disproportionately affected by climate change and air pollution globally.

Finally, actions related to the circular and green economies that mitigate climate change may have other co-benefits for health. WHO's briefings on health in the green economy (Hosking et al., 2011; Röbbel N, 2011; WHO, 2011a–c) identify a number of these, including occupational health gains from more energy-efficient building and transport infrastructure; for example, low-energy office buildings and workplaces that offer good daylight and natural ventilation can often improve workers' health and productivity. These actions may also bring increased health risks; for example, workers may be exposed to hazardous chemicals in the production of certain types of solar panel, which need to be mitigated (WHO, 2011c).

7.8 Air pollution

This section summarizes the broad range of effects on air pollution from a transition to a circular economy model, along with related health implications. Air pollution is a major worldwide risk to health, connected to a number of cardiovascular and respiratory diseases and other conditions, including lung cancer. A recent review by the royal colleges of Physicians and of Paediatrics and Child Health in the United Kingdom found that air pollution affects health throughout the life-course, and cited emerging, if not conclusive, evidence for obesity, dementia and diabetes as health impacts (RCP, 2016). WHO (2016a) estimates that outdoor air pollution caused about 3 million premature deaths globally in 2012, with 87% in low- and middle-income countries. Consequently, any programmes of action that significantly reduce air pollution can play an important role in tackling the associated health impacts.

The circular economy literature and action plans recognize that this model can help to address many environmental challenges (e.g. EC, 2015a; EEA, 2016). In particular, a range of circular economy actions and policies can support the reduction of air pollution. The types of such actions identified in this report include the following.

- The direct impacts of greater recycling and reuse of products, components and materials, as well as shifts towards product sharing and product as a service models, will **reduce the generation of non-recovered waste** and therefore its associated environmental impacts, including air pollution, of landfilling and incineration. While this has clear benefits for air quality in the EU, the requirements of the Industrial Emissions Directive (which limits emissions from, for example, incinerators) limits the scale of the benefit. Benefits will be perhaps substantially greater in countries with weaker emission standards.

- **Indirect impacts of recycling and reuse of products, components and materials** could result from reducing the environmental impacts from manufacturing processes, including air pollution, due to reduced resource extraction and processing emissions. For example, Grimes et al. (2008) estimated that energy savings of 90–95% can be achieved for secondary aluminium production, compared with primary production.

- **Shifts to product sharing and product-as-service models** also have the potential to reduce overall environmental impacts, including air pollution, from manufacturing processes and product use. Guidelines on appropriate product sharing are needed to guard against more intensive use of more polluting products.

- The move towards **greater use of renewable energy and energy efficiency** will reduce air pollutant emissions to the extent that there is a switch away from modes of energy production and transport with greater air emissions, especially fossil fuels.

Specific examples of where circular principles can affect air pollution cited elsewhere in this report include the following.

- The **implementation of circular building principles** is seen as resulting in safer construction conditions, due to the use of nontoxic materials and improved indoor air quality (see the case study on the built environment).

- There are potential air quality improvements from **car sharing** to the extent that more intensive use of vehicles could reduce overall traffic and pollutant emissions. The environmental impact of car sharing will also depend on the extent to which newer, less polluting cars are used in schemes and on the replacement rate.

- The third example is **e-waste disposal**, although one should recognize the increased risks from air pollution (and other environmental health risks) from unregulated recycling, such as at informal e-waste processing sites (see the case study on e-waste).

The link to climate change should also be noted here, since circular economy actions that reduce GHG emissions (as described in the case study on climate change) also lead to reduced air pollution emissions of particulate matter, sulfur dioxide and nitrogen oxides. An estimate of averted health impact from this decrease in air pollution is given above: the estimated reduction of 500 million tonnes in GHG emissions in the EU (EC, 2015a). The improved air quality from such actions is valued at about US$ 5.7 billion, which is an order of magnitude greater than that of the averted mortality from exposure to extreme heat given in the case study on climate change (J. Spadaro, Researcher, Environmental Sciences, Bilbao, Spain, personal communication, August 2017).

More research is needed to quantify the range of other potential health effects resulting from circular economy actions that reduce air pollution, and to consider more fully the distributional impacts of these actions. As in the case of climate change, these actions are likely to benefit vulnerable groups. For example, any health benefits from reducing vehicle emissions may have greater benefits for urban poor people who live close to congested areas, and lower emissions from landfill may benefit those who live near landfill sites.

8 Policy options

8.1 Overview of policy options for supporting the transition towards a circular economy

Table 1 in section 3 presented an overview of types of policy options for supporting the circular economy, including examples for regulatory frameworks; economic instruments; education, information and awareness; research and innovation policy; and public procurement. While the strategy and regulatory framework need to be set at the EU and national government levels, to create the conditions enabling circular economy initiatives to thrive, business and civil society have a crucial role in the transition. Key policy actions in support of a circular economy need therefore to be based on collaboration with business and civil society, with, for example, business supported via best practice knowledge sharing and pilot projects (Benton & Hazell, 2013). Section 3 gives details of the EU action plan and progress at the national, civil society and business levels.

The literature on policy options for this transition emphasizes the need for a mix of complementary instruments and approaches, including regulatory measures, economic incentives, education and awareness raising, and targeted funding for innovation and research (EC, 2014b; EMF, 2015c; Preston, 2012). It also highlights the barriers that need to be tackled for a successful transition, including the needs for: enhanced skills and investment in circular product design and production, investment in recycling and recovery infrastructure, economic incentives for efficient resource use and internalization of externalities, increased consumer and business acceptance of innovative consumption models (e.g. leasing rather than owning), increased information (e.g. on chemical composition of certain products) and sufficient waste separation at source (e.g. for food waste and packaging) (EC, 2014b).

An EC (2014b) study identifies a number of general policy priorities for accelerating the transition to a circular economy, focusing on those most relevant for EU policy. The priority materials given include: agricultural products and waste, wood and paper, plastics, metals and phosphorus. Priority sectors include: packaging, food, electronic and electrical equipment, transport, furniture, buildings and construction.

8.2 Policy options for addressing the health-related implications of circular economy policies

The most relevant policy options to address the most significant and direct identified potential health impacts from circular economy actions would seem to lie chiefly in the categories of regulation; education, information and awareness; and research given in Table 1. The precautionary principle could then be applied to enable policy responses where there is potential harm to human health, even though scientific research has not yet completely evaluated the risks, exposures and health endpoints, including distributional effects. The EC (2000) Communication on applying this principle highlights the need to find the correct balance so that "proportionate, non-discriminatory, transparent and coherent actions can be taken". Thus, some direct regulation might be justified where research gaps exist, but there is reasonable suspicion of serious health implications. Four key policy areas should be highlighted in this context.

- Revisions of EU legislation in relation to emerging health concerns continue the process of **regulation**. For example, the REACH Regulation recently banned BPA in thermal paper in the EU from 2020, owing to health concerns, as outlined in the case study on chemicals of concern in products. Amendments to the RoHS Directive are proposed to prolong the use of electrical and electronic equipment and postpone their end of life and disposal, thus avoiding additional generation of hazardous waste (EC, 2017b).

- Better flows of **information** on component materials in products are needed to better inform recyclers of the need for their safe removal and to help prevent the use of harmful substances in recycled materials. For example, the STEP Initiative supports work to identify and remove hazardous components in e-waste.

- Significant gaps in **research** exist, especially quantitative analysis of exposures and endpoints related to the identified potential health impacts. Continuing support for detailed research on specific identified health impacts will aid targeted regulation and information on chemicals of concern in waste flows. Research should also focus on finding less harmful substitute materials, as promoted in the work of a number of initiatives (e.g. EMF, 2015b).

- **Action on the informal waste sector** is needed because its activities in collection, treatment and disposal, and the illegal flows of hazardous waste are suspected to be significant, although complete information on this issue is lacking. For example, Europe exports high quantities of e-waste to developing countries that lack adequate waste management infrastructure, so that handling and disposal are frequently unregulated or health and safety regulations are not enforced. As shown in the case study, this directly and disproportionately affects the health of vulnerable and poor people working at and living near waste dumping sites. The implementation and enforcement of the Basel Convention through national and international legislation is central to tackling this issue (WHO Regional Office for Europe, 2016b).

In addition to tackling direct negative health effects, policy options can also be used to enhance positive effects. For example, a policy discussion on appropriate economic instruments in the circular economy model suggested a shift in taxation from labour to resources (Stahel, 2010). This would increase incentives to minimize waste, maximize resource productivity and encourage more labour-intensive circular business practices. Since about 6% of total tax revenues in Europe currently come from environmental taxes (including on pollution and resource extraction) and about 50% come from labour taxes and social contributions, this shift could represent a significant change (EMF, 2015c). An analysis for the Ex'Tax project (Ex'Tax et al., 2016) suggests that such a shift in 2016–2020 would produce positive results in the EU27, including a GDP 2% higher on average and employment 2.9% higher (an increase of 6.6 million) than the business-as-usual scenario. Sector analysis shows employment gains in most sectors except energy and utilities, with most gains in wholesale/retail, communication and basic manufacturing, and lower gains in agriculture. The study also highlights the potential for health benefits from this shift in tax policy in terms of lower carbon emissions and pollution levels due to reduced energy, resource and water use, as well as increased well-being from employment effects defined in terms of ensuring material needs, participation in society and social status (Ex'Tax et al., 2016).

This example of a shift in taxation policy illustrates that, while many policy actions related to the circular economy may not have originally and mainly been intended to secure health benefits, these actions have considerable co-benefits, as mentioned and discussed in sections 6 and 7. These include health co-benefits through reduced emissions from manufacturing processes and vehicles, cost savings in hospitals, improved occupational health and safety benefits from changes in the built environment, and a greater choice of healthy foods. As mentioned, however, there are potential negative health impacts or co-costs associated with circular economy actions, for example, in relation to chemicals of concern, e-waste and food packaging.

9 Conclusions

This section gives the key conclusions from this study, including both general conclusions; specific conclusions for various stakeholders: policy-makers, researchers, businesses/NGOs and civil society; and the conclusions from a recent WHO meeting.

9.1 General conclusions

- The circular economy concept has achieved prominence and wide engagement among the academic, policy, business and NGO communities over recent years. The current state of play for the implementation of its principles encompasses a wide range of activities, summarized for Europe in section 3, most noticeably in the waste sector.

- Assessments of health impacts from the circular economy (e.g. WHO Regional Office for Europe, 2016b) focus on the direct effects of waste management activities (landfill, recycling, etc.), but the full implementation of the wider definition of the circular economy may potentially have significant indirect health effects resulting from, for example, changes in environmental impacts from extraction, production, mobility and consumption.

- The assessment of health implications in this study found many existing and potential positive health implications related to the reduced use of primary resources" and "maintaining the highest value of materials and products, such as through the recycling and reuse of products, components and materials, and the move towards greater use of renewable energy and energy efficiency. In particular, these benefits come through cost savings in the health sector and the indirect health benefits of reducing environmental impacts on air, water and soil quality and GHG emissions from manufacturing processes.

- There are also potentially significant health benefits from changing utilization patterns through, for example, the health care sector's introducing performance models in the procurement of equipment, and a wide range of indirect health benefits due to the reduction in environmental impacts from shifts to product sharing and product-as-service models.

- The potential negative health impacts identified relate to the unintended consequences of recycling and reusing products, components and materials. This refers in particular to the management of chemicals of concern, such as those found in e-waste, food packaging and fire retardants in a variety of products, and to emissions from the composting of waste. The challenge for the circular economy in this context is the development of safer, effective and economically viable replacement materials. This is a key step in managing the transition from a linear to a circular economy.

- Although conclusions for key stakeholders are set out below, multistakeholder partnerships and collaboration between WHO Member States, NGOs, intergovernmental organizations, the private sector and academe through agreed partnerships and action plans are vital to drive progress in promoting the health benefits and addressing the health risks entailed in the transition to a circular economy.

9.2 Policy

- Policy priorities for addressing the areas of immediate concern identified in consultations for this report are:

- the further development of regulations for some direct negative health impacts, such as the recent banning of BPA in thermal paper in the EU from 2020;

- better information to inform recyclers and help prevent the use of harmful substances in recycled materials;

- support for research on the health impacts of recycling materials; and

- action to address health impacts at informal waste sites, including reducing the risk of exposure to hazardous materials.

- There are also broader priorities in terms of developing indicators for the monitoring of progress on the health benefits and on reducing the health risks of circular economy programmes, including taking account of distributional effects.

- Promoting public awareness of circular economy benefits, including health benefits, is also a key to progress. This includes changing perceptions of the quality and safety of remanufacturing, refurbishment and reuse of products and components (e.g. hospital equipment) and the benefits of shifts in consumption models (e.g. product sharing).

- The distribution of health impacts is of particular importance. More vulnerable populations may be disproportionately affected by both the negative health consequences of specific circular economy actions outlined in this report (as shown by the examples given in the case studies on chemicals of concern and e-waste) and the health benefits of circular economy actions (by addressing inequitable environmental determinants of health, such as air pollution and soil contamination). Thus, further policy development in this area, informed by ongoing research on distributional issues, is essential.

- Actions to address areas of concern are urgent, to prevent progress on the circular economy (and the potential for significant health benefits) being undermined by reduced public and policy community support resulting from these concerns.

- In view of this report's findings on the importance of health issues in the transition to a circular economy and the relatively limited coverage of these to date, it is clearly necessary to increase and improve the placement of health in policy discussions and future circular economy strategies, frameworks and action plans at the national, regional and global levels.

- To this end, WHO and the health sector should be active, key stakeholders in supporting the transition process. This would enable both positive and negative health considerations to be better integrated into circular economy strategies and national implementation plans. This involvement would also support concrete actions to address areas of health concern in the transition.

9.3 Research

- Much continuing research addresses the potential health impacts of a transition to a circular economy in the context of, for example, chemicals of concern, water reuse and e-waste. There are significant research gaps, however, especially in the quantitative analysis of exposures and endpoints related to the identified potential health impacts. It is also necessary to further develop the assessment of the effect on the environment and health of alternative policy options, for example, in the management of residual waste.

- Some aggregate estimates of potential benefits from circular economy policies are available, sometimes including health estimates (e.g. EMF, 2015b; Ex'Tax et al., 2016), but their authors acknowledge that these are order-of-magnitude estimates and that more detailed quantitative analyses of specific benefits and identified health impacts are needed. Further analysis to better understand potential health benefits could also be used to inform the development of policies and practices to enhance such benefits.

- There is also a priority need for more assessment of the health implications of a circular economy for the countries in the WHO European Region that do not belong to the EU. While this report aims to cover all the countries in the Region, the availability of consolidated data and analysis on a range of circular economy issues is much greater in EU countries. In addition, the business and policy communities in EU countries have greater engagement with the circular economy concept. More information is therefore needed on the state of play and progress being made on key circular economy issues and their health implications in countries outside the EU, including on waste management and resource efficiency. This would better inform an understanding of key policy priorities in these countries.

- Given the importance of inequity in health in key programmes such as Health 2020 and the SDGs (WHO Regional Office for Europe, 2013; United Nations, 2018), research and policy development need to give further emphasis to the distributional issues outlined in this report, in order to minimize the negative outcomes and promote positive outcomes for vulnerable populations.

9.4 Businesses/Civil-society organizations

- Business plays a crucial role in implementing circular principles, including through innovation, ecological design, resource efficiency and waste minimization, while civil-society organizations (CSOs) and business associations support this via promotion and knowledge sharing. Such approaches can be seen as integral to triple-bottom-line outcomes (that is, social, environmental and financial outcomes) for business.

- These actions can be the source of key direct positive health implications (e.g. via performance models and sharing platforms in procurement in the health care sector) and indirect implications via reducing environmental impacts (air, water and soil quality, and GHG emissions) in extraction, manufacturing and consumption processes.

- Business and CSOs can also play a key role in identifying and addressing the potential unintended consequences of circular economy actions. In particular, this refers to the challenges identified above in managing the presence of chemicals of concern in recycling and reusing products, components and materials, and developing safe substitute materials.

- A number of potential occupational health impacts from the circular economy transition have been identified. For example, health benefits are envisaged from using circular principles in the built environment to improve safety, air quality and mental health. Occupational health risks include those associated with use of chemicals of concern and poorly regulated e-waste sites. While further research is required to identify and assess these impacts, the active business and CSO networks for a circular economy can play a key role in promoting healthy outcomes and addressing potential occupational health risks.

- CSOs also have a key role in assisting and reviewing the development and implementation of policy related to the circular economy, identifying and reporting health-related issues and advocating changes in policy, business practice and consumer choices.

9.5 General public and the mass media

- Using circular principles can have a range of possible public health benefits, including improvements in safety, air quality and mental health in the built environment. There are also potentials gains to public health to the extent that savings in the health care sector (discussed in the case study in section 7) result in improvements in services. Indirect public health benefits may also occur through reductions in pollutant emissions from production and consumption processes.

- There are also public health risks from, for example, contact with chemicals of concern in products and components. These risks are an emerging area of research and require much more assessment.

- The general public and the mass media can become more engaged in the circular economy in a number of ways; this would enable them to inform, stimulate and contribute to healthy outcomes through, for example, lower production and consumption emissions. These opportunities include behavioural changes such as involvement in sharing platforms (e.g. car sharing) and consumer choices (e.g. recycling products and reused components).

9.6 Conclusions and recommendations of environment and health stakeholders

The following are the conclusions reached by the participants in a WHO meeting on the circular economy and environment and health, held in October 2017 in Bonn, Germany. The participants included representatives of the European Environment Agency, the United Nations Environment Programme, UNIDO, the United Nations Economic Commission for Europe, United Nations University, funding agencies such as the World Bank and the European Investment Bank, the Organisation for Economic Co-operation and Development, CSOs such as HEAL and EuroHealthNet, the private sector, young people's organizations and academe.

- Circular economy concepts and business models will increasingly replace the present dominant linear economy. The reasons for this change are manifold: the inefficient use of finite resources, limitations of GDP-focused economics, interest in indicators of well-being, internalization of the costs of climate change and awareness of planetary boundaries.

- Although largely absent from past discussions, the health sector should become actively involved as an enabler and key stakeholder in this transition process. Both positive and negative health considerations must be integrated into circular economy strategies and national, regional and local implementation plans.

- The transition to a circular economy can result in potentially significant net health benefits that will contribute to the attainment of the SDGs, particularly SDGs 3, 9, 11 and 12.

- WHO and the health and environment sector should promote a health-friendly transition to a circular economy and actively support countries in defining their strategies and translating them into national, regional, and local action plans.

- Joint action is required to ensure an effective and safe transition to a circular economy; every sector has to be engaged, including the public, to remove harmful substances (detoxify), to reduce emissions of GHGs (decarbonize) and other pollutants that affect air quality, to build the capacity of the ecosystem (enhance resilience), and to change lifestyles and use less resources (decouple).

- A circular economy can provide a major opportunity that could yield substantial health benefits, yet there are also risks of adverse effects that need to be identified, investigated, well communicated and integrated into circular economy strategies and implementation plans. Examples of such negative effects are specifically found in the areas of waste management, diffusion of hazardous chemicals and reuse of waste-water.

- Multistakeholder partnerships and collaboration among WHO Member States, CSOs, intergovernmental organizations, the private sector, the mass media and academe are vital to drive health and a sustainable circular economy forward through partnerships and action plans.

- The adoption of circular economy principles is an essential part of new business models and evidence suggests that it is expected to result in increased and sustainable growth, profits/taxes, employment and resilience for most private and state actors.

- All individuals – in their various economic and societal roles as consumers, producers, employees, educators, etc. – will have to change their lifestyles, attitudes and behaviour substantially over the next decades. If undertaken in a fair and equitable manner, this transition might enable the most effective and efficient societal transformation and significantly shorten the implementation phase, and thus help to overcome political and private sector concerns.

- Significant gaps in research remain in the area of the positive and negative links between a circular economy and health, particularly for the changing distributional effects. Additional research is needed to establish evidence of the benefits of a circular economy, which should then inform the political debate and implementation activities.

- A framework of environment and health indicators and metrics for human progress should be developed, along with a monitoring and evaluation system, to ascertain and optimize the expected benefits of a circular economy.

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ANNEX 1. CONCEPT OF THE CIRCULAR ECONOMY AND MODELS OF IMPLEMENTATION

This annex provides further detail and discussion on the definition and models of the circular economy, and links to related concepts and initiatives given in section 2.

A1.1 Definitions

The concept of a circular economy evolved over recent decades into its current form by building on earlier related concepts and frameworks, such as the functional service economy (performance economy), the cradle-to-cradle design philosophy and industrial ecology (EMF 2015a; Preston 2012). The literature gives no single definitive and ubiquitous definition of a circular economy, although it shows general consensus on the central concepts and aims. Rizos et al. (2017) identify two main types of definitions: those that are resource-oriented and focus on the need for closed loops of material flows and reduced consumption of virgin resources, and those that go beyond the management of material resources to incorporate additional dimensions, such as changing models of consumption.

In simple terms the types of processes needed for a transition to a circular economy can be categorized as: using fewer primary resources, maintaining the highest value of materials and products, and changing utilization patterns. In practice, the actions needed to achieve this transition include: recycling; efficient use of resources; utilization of renewable energy sources; remanufacturing, refurbishment and reuse of products and components; product life extension; product as service; product sharing; waste prevention, including designing waste out of products, and a shift in consumption patterns (Rizos et al., 2017; EMF, 2015a). Alongside these actions, the phasing down of incineration and landfilling as waste management options is seen as a necessary requirement, although a need remains to assess the best options for dealing with residual waste.

A frequently quoted definition by the Ellen MacArthur Foundation (EMF) sees a circular economy as "one that is restorative, and one which aims to maintain the utility of products, components and materials and retain their value" (EMF, 2015a; EEA, 2016a). A key focus is thus on minimizing the need for new inputs of materials and energy and reducing environmental pressures related to resource extraction, emissions and waste. The concept is also presented as enabling wider economic and social benefits, such as greater well-being, sustainable growth and employment. The main definitions reviewed for this report, however, make no explicit mention of health. Rizos et al. (2017) found that social aspects are often absent from the existing conceptualizations of the circular economy.

Definitions of the circular economy include a number of common themes:

- transition from linear (take, make, use, dispose) model to circular (restorative and regenerative) model (EMF, 2015a) (see Fig. 1).

- aims to keep products, components, and materials at their highest utility and value at all times (this requires the promotion of reuse, repair, reconditioning and recycling (Benton & Hazell, 2013), which contribute to keeping resources in use for as long as possible, extracting the maximum value from them whilst in use, and recovering and regenerating products and materials at the end of their service life (WRAP, 2018));

- closure of material loops;
- distinction between technical and biological cycles (see e.g. Fig. A1.2);
- system-wide innovation aiming to redefine products and services to design waste out and extend product life (see, for example, EEA, 2017), while minimizing negative impacts.

Definitions also include a tie-in of the circular economy model with addressing related economic, social and environmental challenges. These include: resource-related challenges for business and economies (for example, "it offers a model of sustainable growth fit for a world of high and volatile resource prices," according to Preston (2012)), sustainable growth, job creation and reduction in environmental impacts, including carbon emissions.

At a more conceptual level, definitions of the circular economy include aims:

- to decouple global economic development from finite resource consumption;
- to build economic, natural and social capital;[17] and
- to go beyond waste management alone to managing natural resources efficiently and sustainably throughout their life cycles.

At a practical level, the literature includes a number of categorizations for the types of actions or processes that can be undertaken by businesses and others to make the transition to a circular economy (EEA, 2016; EMF, 2015c; WRAP, 2018). For example, the Ellen MacArthur Foundation (EMF) developed the ReSOLVE framework (Regenerate (e.g. shift to renewable energy and materials), Share (e.g. sharing of assets and reuse of products), Optimise (e.g. removing waste in production), Loop (e.g. recycling and remanufacturing), Virtualise (dematerializing consumption) and Exchange (e.g. choosing new sustainable products)) (Fig. A1.1). This categorizes

[17] Definitions from EMF (2018) also include: "It is conceived as a continuous positive development cycle that preserves and enhances natural capital, optimises resource yields, and minimizes system risks by managing finite stocks and renewable flows" (EMF 2015a).

Fig. A1.1. The ReSOLVE framework

REGENERATE	• Shift to renewable energy and materials • Reclaim, retain, and restore health of ecosystems • Return recovered biological resources to the biosphere
SHARE	• Share assets (eg cars, rooms, appliances) • Reuse/secondhand • Prolong life through maintenance, design for durability, upgradability etc
OPTIMISE	• Increase performance/efficiency of product • Remove waste in production and supply chain • Leverage big data, automation, remote sensing and steering
LOOP	• Remanufacture products or components • Recycle materials • Digest anaerobically • Extract biochemicals from organic waste
VIRTUALISE	• Dematerialise directly (eg books, CDs, DVDs. travel) • Dematerialise indirectly (eg online shopping)
EXCHANGE	• Replace old with advanced non-renewable materials • Apply new technologies (eg 3D printing) • Choose new product/service (eg multimodal transport)

Source: EMF (2015c).

actions and processes based on the model in Rizos et al. (2017), which groups types of actions or processes under the headings of: reducing the use of primary resources, maintaining the highest value of materials and products and changing utilization patterns (see Table 2, section 5).

A1.2 Models

Models of the circular economy vary in scope and sophistication from the simple circular concept shown in Fig. 2 (section 2), which describe a production, consumption, reuse/repair/recycling loop, to the more complex outline based on three central principles given in Fig. A1.2 or applied to a specific industry in Fig. A1.3. The principles focus on

- preserving and enhancing natural capital by controlling finite stocks and balancing renewable resource flows:
- optimizing resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles;[18] and
- fostering system effectiveness by revealing and designing out negative externalities.

Negative externalities are any consequences of an economic activity that affect other parties without being reflected in market prices. In this context, externalities with health implications include air, water, soil and noise pollution, and the release of toxic substances.

A number of frameworks also set out processes and actions needed for a transition to a circular economy (EMF, 2015c; Benton & Hazell, 2013; Preston, 2012). For example, uses the ReSOLVE framework identifies a set of six types of actions that businesses and governments can take. Circular economy models do not vary widely in terms of stakeholder roles for implementing such actions. Thus, there is a general understanding that a transition must include state intervention in setting strategy and funding some measures, such as research and business support, regulatory and fiscal frameworks supporting actions by business. There is also a key role for nongovernmental organizations (NGOs) and business associations in promotion and knowledge sharing. Due to the wide scope of what may be defined as circular economy actions, there are many examples of businesses, organizations and governments implementing policies that are consistent with the circular economy but use different terminology (Preston, 2012).

A1.3 Related concepts and initiatives

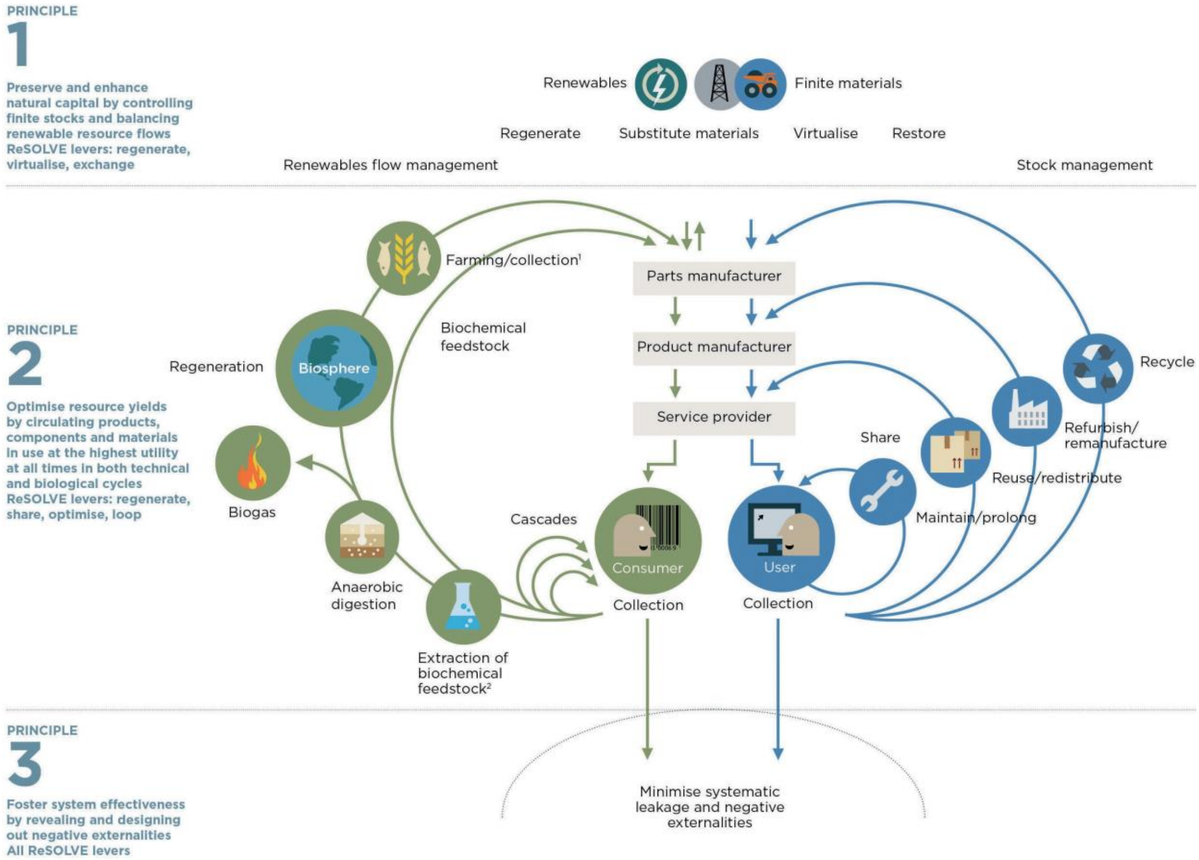
This section provides a brief outline of a number of related concepts and associated global and European initiatives, focusing on their links with the circular economy concept.

A1.3.1 Sustainable development and the Sustainable Development Goals (SDGs)

The circular economy can be seen as a means of progressing towards sustainable development through reaching the SDGs (United Nations, 2018). The European Union (EU) action plan for the circular economy (detailed in section 3) explicitly links the circular economy to the implementation of global commitments under the United Nations 2030 Agenda for Sustainable Development. It states that the action plan will be "instrumental in reaching the SDGs by 2030, in particular Goal 12 of ensuring sustainable consumption and production patterns" (EC, 2015).

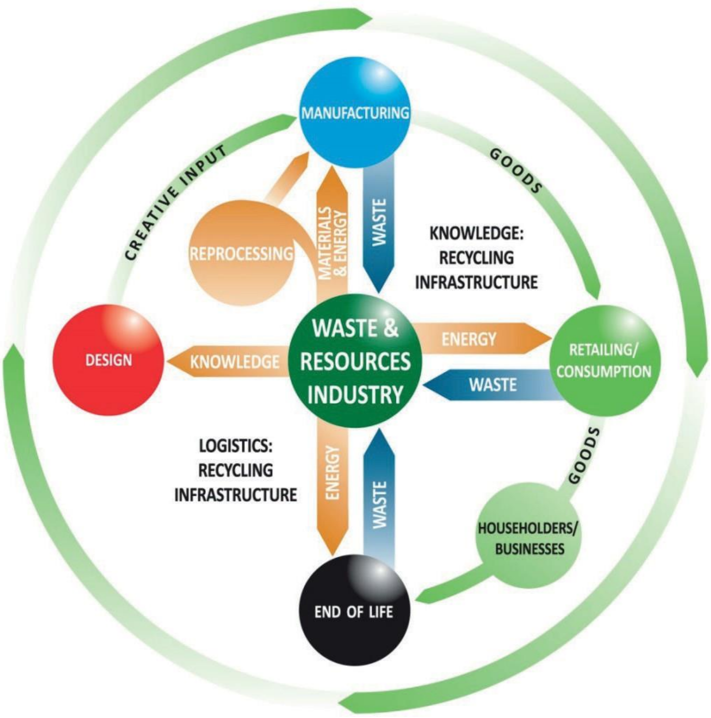
[18] In this model, a circular economy distinguishes between technical and biological cycles. The technical cycle involves the management of stocks of finite materials. Use replaces consumption. Technical materials are recovered and mostly restored. The biological cycle encompasses the flows of renewable materials. Consumption only occurs and renewable (biological) nutrients are mostly regenerated.

Fig. A1.2. Outline of circular economy according to three key central principles



Source: EMF (2015b).

Fig. A1.3. Modelling the circular economy with the waste and resource industry at the centre



Source: Environmental Services Association (2016).

The targets of particular relevance in SDG 12 are:

- to achieve the sustainable management and efficient use of natural resources (12.2);
- to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including postharvest losses (12.3);
- to achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment (by 2020) (12.4.); and
- to substantially reduce waste generation through prevention, reduction, recycling and reuse (12.5).

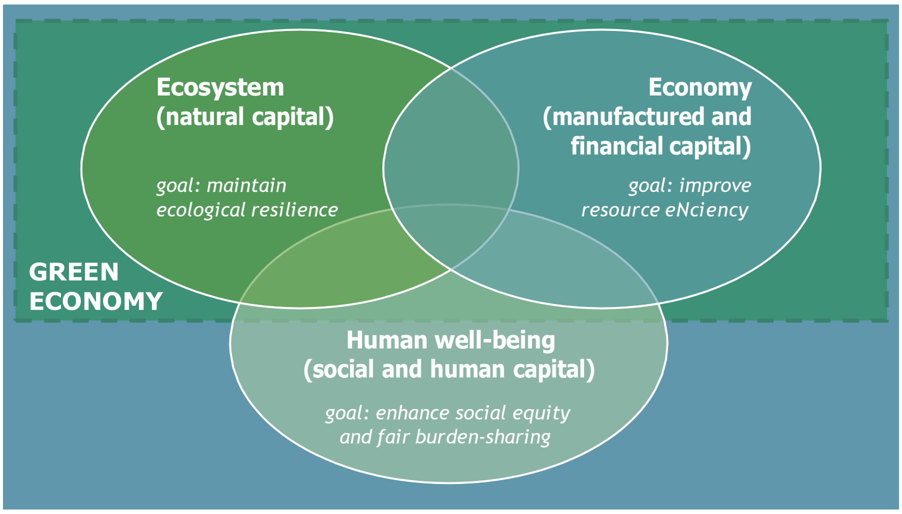
Some sources also see the transition to a circular economy as contributing to a number of the other SDGs. For example, EMF (2017) links the transition to helping to achieve SDGs 3 (on good health and well-being), 7 (on affordable and clean energy), 8 (on decent work and economic growth), 9 (on industry, innovation and infrastructure) and 11 (on sustainable cities and infrastructure).

A1.3.2 Green economy

The concepts of the green economy and the circular economy are closely interlinked. Indeed, the terms are sometimes used together to underline their interconnectivity. The working definition of a green economy used by the United Nations Environment Programme (UNEP)[19] is "one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011). Thus, this includes key features of a circular economy, particularly low-carbon approaches and resource efficiency, but has been interpreted as being wider in range in that it includes social and ecosystem dimensions. References to the circular economy in the UNEP Green Economy documents focus mainly on issues of waste and use of materials (Fig. A1.4). Nevertheless, some circular economy reports include the discussion of social and ecosystem benefits as part of a wider assessment of initiatives (e.g. EMF, 2015b). The green economy is also closely linked to sustainable development and, in the 2012 Rio+20 agenda, is seen as a tool for achieving sustainable development (United Nations, 2012).

[19] UNEP launched the Green Economy Initiative in 2008. It includes global research and country-level assistance aimed at motivating support for green economy investments as a way of achieving sustainable development.

Fig. A1.4. The green economy



Source: EEA (2016b).

A1.3.3 Batumi Initiative on Green Economy

The Batumi Initiative is a set of voluntary commitments by European countries and organizations to undertake green economy actions, including actions for the circular economy. It serves to enable the Pan-European Strategic Framework for Greening the Economy in the period 2016–2030 (UNECE, 2016b). Focus area 5 of the Strategic Framework is to "Develop clean physical capital for sustainable production patterns"; it explicitly refers to the circular economy approach in the context of encouraging closed-loop material cycles and eco-design of products. Focus area 4 is to "Shift consumer behaviours towards sustainable consumption patterns" including the circular economy aims of "efficient use of water, energy and materials, and the minimization of waste generation" (UNECE, 2016a). The Green Growth Knowledge Platform (2018) promotes the Batumi Initiative by providing information on the commitments of countries and organizations.

A1.3.4 Resource efficiency agenda

The circular economy is also closely linked to the concept of and initiatives on resource efficiency. The EU Roadmap to a Resource Efficient Europe (part of the Europe 2020 Strategy) outline the circular economy is as an interlinked initiative in terms of sustainable materials management where waste becomes a resource (EC, 2011). The European Resource Efficiency Platform (EC, 2018), which aims to provide high-level guidance to the European Commission, Members States and private actors on resource-efficiency, includes moving towards a circular economy in its manifesto (EREP, 2014). The EU action plan for the circular economy (EC, 2015b) also links the circular economy to the implementation of global commitments under the Group of 7 Alliance on Resource Efficiency.

A1.3.5 Low-carbon economy

This term refers to a transition towards a competitive low-carbon economy and largely focuses on the supply side of economies. The European Commission (EC) roadmap to a resource efficient Europe set a target for the EU to cut greenhouse gas (GHG) emissions to 80% below 1990 levels by 2050, and outlines required contributions across all main sectors responsible for Europe's emissions (EC, 2011). Health benefits are foreseen due to improved air quality. Low-carbon approaches are included in the circular economy model (and the green economy concept), but the concept is narrower in focus.

A1.3.6 The bioeconomy

The bioeconomy is defined as the parts of the economy that use renewable biological resources from land and sea (such as crops, forests, fish, animals and micro-organisms) to produce food, materials and energy. The EC bioeconomy strategy proposes a comprehensive approach to address the ecological, environmental, energy, food supply and natural resource challenges faced by Europe (EC, 2012). This concept is the focus of a key element of the circular economy model, which includes optimizing resource yields in biological cycles, as well as technical cycles, as outlined in principle 2 of the circular economy model developed by EMF (see Fig. A1.2).

A1.4 Linkage to existing WHO programmes and publications

While WHO programmes and publications make limited direct reference to the circular economy concept, some of its key health initiatives connect to and are affected by circular economy aims and policies, primarily in the area of the green economy, the environment and sustainable development.

A number of WHO briefings on health in the green economy (Röbbel, 2011; WHO, 2011b–d) review the health impacts of the strategies for mitigating climate change considered by the Intergovernmental Panel on Climate Change in its fourth assessment report (Pachauri & Reisinger, 2007). They identify expected health co-benefits from some of these strategies, including from the issue of waste management, and note that others may involve health risks or trade-offs. A number of WHO sector reports, including for health care, housing and transport, and other reports on household energy and occupational health identify opportunities for potential health and environment synergies (WHO, 2011a–d). The findings of these reports were used to inform the assessment of health impacts in section 6 above.

Health 2020 is the European health policy framework adopted by Member States of the Region in September 2012 (WHO Regional Office for Europe, 2018). It aims to support action across government and society to: "significantly improve the health and well-being of populations, reduce health inequalities, strengthen public health and ensure people-centred health systems that are universal, equitable, sustainable and of high quality" (WHO Regional Office for Europe, 2013).

The transition to a circular economy has various implications for the stated priorities of Health 2020 (WHO Regional Office for Europe, 2013).

As to tackling Europe's major disease burdens, the circular economy may affect the burden of disease positively (e.g. though reduction of air pollution due to transition to the circular economy mobility and production modes – see section 5) and negatively (e.g. if hazardous chemicals are not managed to minimize health risks – see the case study in section 7).

- As to **strengthening people-centred health systems and public health capacity**, the circular economy can contribute to improving the delivery of public health and health care services by providing a range of cost-saving and efficiency measures (see the case study in section 7).

- The transition to the circular economy can enhance **the creation of supportive environments and resilient communities** to the extent that this translates into improved well-being and quality of life (see discussion on models of a circular economy and examples in the case study on the built environment in section 7).

Further, successful health outcomes for the populations of Europe from progress towards Health 2020 will support the healthy workforce required for the successful development of a circular economy.

Waste was one of the eight themes of the **European environment and health process** roadmap to the Sixth Ministerial Conference on Environment and Health of the **European environment and health process** (WHO Regional Office for Europe, 2015). It was indicated as one of the key environmental and health issues not yet adequately explored and addressed by the Process. The WHO Regional Office for Europe held an expert consultation on the health effects of urban and hazardous waste in support of the Process (WHO Regional Office for Europe, 2016a).

Most recently, the Declaration of the Sixth Ministerial Conference on Environment and Health states that progress on actions towards improving the environment and health "can be accelerated and sustained by enhancing interdisciplinary research and supporting the transition to a green and circular economy as a guiding new political and economic framework" (WHO Regional Office for Europe, 2017).
In particular, the objective to "Prevent and eliminate the adverse environmental and health effects, costs and inequalities related to waste management and contaminated sites" includes "supporting the transition to a circular economy using the waste hierarchy as a guiding framework to reduce and phase out waste production and its adverse health impacts through reduction of the impact of substances of greatest concern" (WHO Regional Office for Europe, 2017).

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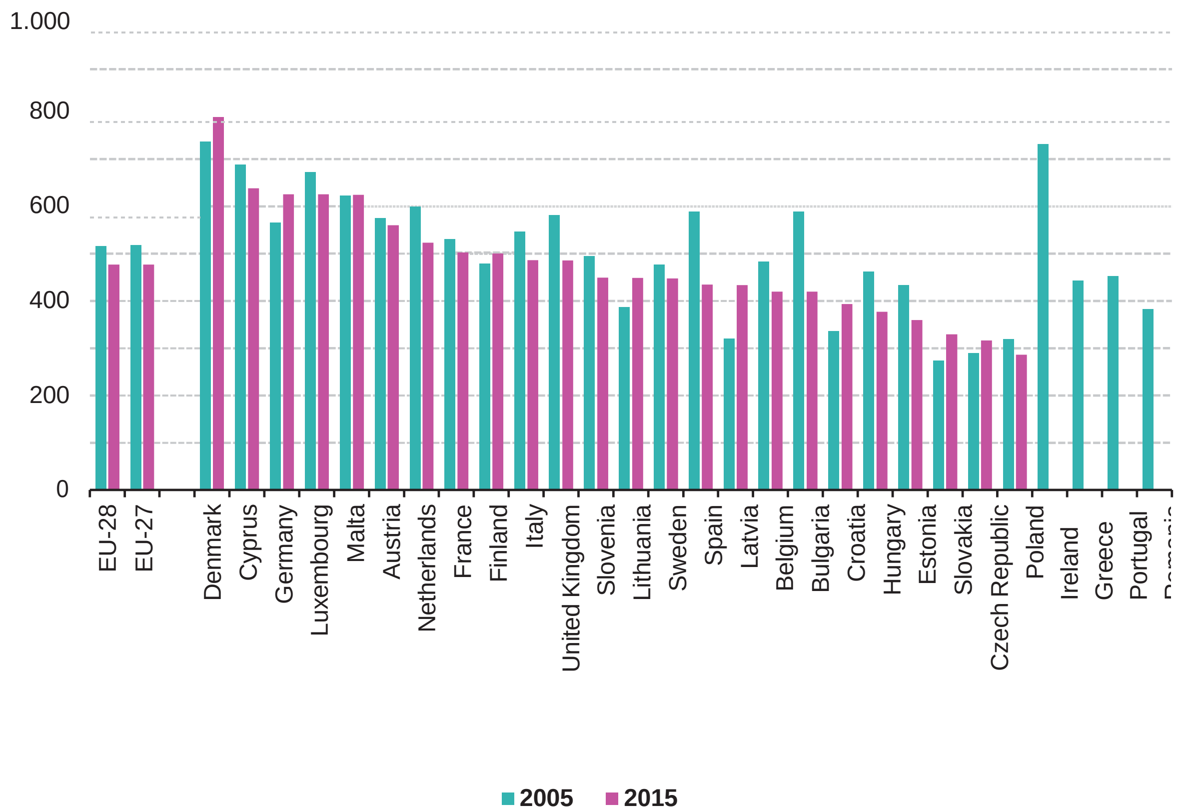
ANNEX 2. PROGRESS TOWARDS CIRCULAR ECONOMY OBJECTIVES

This annex provides further detail on the current state of play in progress towards a circular economy in Europe given in Section 3.

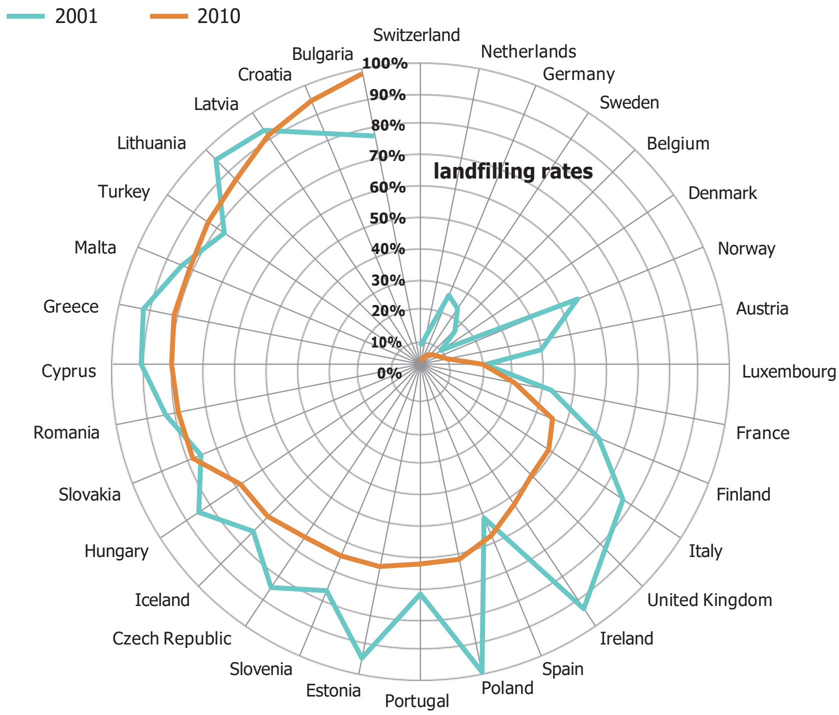
When one focuses on practical progress towards circular economy objectives, one notes an interesting overall trend towards declining waste generation per capita in the EU, where the overall decline was about 7% in the period 20042013, with a decrease of 4% in municipal waste generation, although caveats are needed owing to missing data, uncertainties and differences in waste calculation methods between countries (WHO Regional Office for Europe, 2016). Fig. A2.1 shows municipal waste generation per capita declining in most EU countries, and in the averages for the 27 countries belonging to the EU between 1 January 2007 and 30 June 2013 (EU27) and the 28 belonging to it from 1 July 2013 (EU28), between 2005 and 2015. Progress was also made in waste management with, for example, increasing percentages of municipal waste recycled and composted across the WHO European Region (including some countries outside the EU) between 2004 and 2014 (see Fig. 5 in section 3). Fig. A2.2 shows landfilling rates for municipal waste and recycling rates for material and biowaste in 2001 and 2010 in 32 European countries.

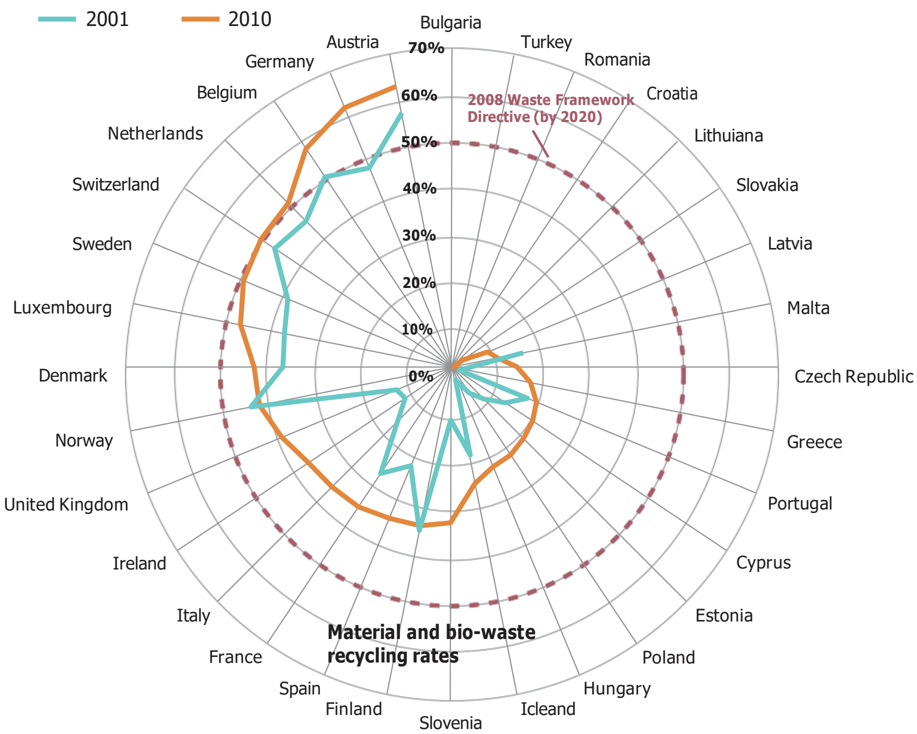
Fig. A2.1. Municipal waste generated by country in 2005 and 2015, sorted by 2015 level, kg per capita



Source: data from Eurostat, 2015.

Fig. A2.2. Landfilling rates for municipal waste and recycling rates for material and biowaste in 32 European countries, 2001 and 2010





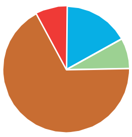
Source: EEA (2013).

Countries vary significantly, many more of that that recently joined the EU having lower recycling and composting rates and much greater use of landfills. Fig. A2.3 demonstrates such differences in these rates between the EU's 15 Member States before 2004 and the 13 that have joined since 2004 (EU15 and EU13, respectively).

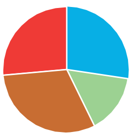
The review by the WHO Regional Office for Europe (2016) notes the large differences between and within European countries in waste management practices; some countries have old technologies and high levels of informal disposal, including open-air dumping and burning of waste. Fig. 4 (section 3) shows overall trends in municipal waste treatment (kg per capita) for EU27 as a whole for the period 1995–2015, with gradual declines in landfill and gradual increases in recycling, composting and incineration.

Fig. A2.3. Comparison of rates of recycling, composting, incineration and landfill between EU15, EU13 and EU28 (note for WHO lay-out company: it would be better to have the percentages placed next to the various pie slices and to enlarge them a bit)

EU15: 29% recycled, 17% composted, 29% incinerated, 25% landfilled



EU13: 15% recycled, 7% composted, 7% incinerated, 61% landfilled



EU28: 27% recycled, 15% composted, 26% incinerated, 30% landfilled

■ Recycled ■ Composted ■ Incinerated ■ Lanfilled

Source: data from Eurostat, 2013.

References[21]

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ANNEX 3. KEY INITIATIVES FOR THE CIRCULAR ECONOMY AT THE NATIONAL AND OTHER LEVELS

Country	Initiative	Description
European countries		
Denmark	Circular Economy Hub	White Paper by State of Green and Danish Ministry of Environment and Food that describes issues and examples but does not give an action plan
Finland	Roadmap to a circular economy 2016–2025	Initiative of Sitra (Finnish Innovation Fund) with wide Government and stakeholder participation, that aims to clarify actions needed to achieve Government target of making Finland a global leader in the circular economy by 2025, and has five focus areas: a sustainable food system, forest-based loops, technical loops, transport and logistics, and joint actions
Luxembourg[a]	Circular economy roadmap, commissioned by the Luxembourg Ministry of the Economy	Study covering circular economy enabling mechanisms, commercial applications and potential roadmap
Netherlands	A circular economy in the Netherlands by 2050	Government-wide programme with priorities for biomass and food, plastics, manufacturing, construction and consumer goods
Scotland (United Kingdom)	Making things last: a circular economy strategy for Scotland	Strategy setting out priorities for moving towards a more circular economy: food and drink and the broader bioeconomy, remanufacture, construction and the built environment, energy infrastructure
European regions and cities		
Brussels Region	Regional Circular Economy Programme: 2016–2020	Objectives to transform environmental objectives into economic opportunities, anchor the economy to produce locally where possible, and help create employment
Amsterdam	Circular Amsterdam: A Vision and Action Agenda for the City and Metropolitan Area	Vision and strategy for circular construction chain and circular organic residual streams chain
Peterborough	Future Peterborough programme	Circular Peterborough Commitment supported by individuals, communities and businesses

	Health-related aspects	Key reports
	No explicit focus on health	State of Green (2016)
	Guiding principles acknowledge the need to manage any health and environmental risks associated with reuse and recycling. Diet issues are included in a focus area: sustainable food system.	Sitra (2016)
	Study includes several references to and examples of the need for healthy materials for a circular economy. It also includes a section on health care and concludes: "... so far none of the leading publications on the circular economy attempted to tackle the health care question despite the large implications for materials, jobs, cost savings and competitiveness" (EPEA, 2014).	EPEA (2014)
	Includes references to but no specific actions on: reducing exposure to substances that damage health; saving costs of health care; and dietary benefits	Government of Netherlands (2016)
	No health focus, except for reference to health and safety in section on skills in a circular economy	Scottish Government (2016)
	No specific health focus	Brussels Government (2016)
	No specific health focus	Circle Economy et al. (2015)
	No specific health focus	Future Peterborough (2018)

Country	Initiative	Description
Examples from countries outside the WHO European Region		
China	Circular Economy Development Strategy and Near-term Action Plan	Circular Economy Promotion passed in 2009, focusing on reducing resource use, reuse and recycling, and followed by a development strategy and action plan
Canada	New thinking: Canada's roadmap to smart prosperity	Broad vision and roadmap for transition, outlining goals and general actions

[a] Luxembourg was the 2017 hotspot for the circular economy under an initiative of the "Circle Economy" network, to exhibit the progress made over the previous two years (Government of Grand Duchy of Luxembourg, 2018).

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	Health-related aspects	Key reports
	No specific health focus found in sources	State Council of the People's Republic of China (2013)
	General statements promoting the circular economy as enhancing environmental and human health and improving workforce health in Canada	Smart Prosperity Secretariat (2016)

Smart Prosperity Secretariat (2016). New thinking: Canada's roadmap to smart prosperity. Ottawa: Smart Prosperity Institute (http://institute.smartprosperity.ca/sites/default/files/newthinking.pdf).

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ANNEX 4. KEY ORGANIZATIONS AND NETWORKS ACTIVE IN THE CIRCULAR ECONOMY

Organization/ Network	Description	Circular economy activities
Aldersgate Group (United Kingdom)	Alliance of leaders from business, politics and civil society that drives action for a sustainable economy	Work on resource efficiency includes a particular focus on engaging EU institutions around the design of the EU's new circular economy package. 2017 report includes a range of case studies (such as those taking part in the REBus project funded by the EU Financial Instrument for the Environment LIFE+) and policy recommendations on the need for the circular economy package
Alliance for Circular Economy Solutions (ACES) (Europe)	New collaboration of businesses and think tanks committed to ambitious circular economy policy in Europe, including the Green Alliance, the Aldersgate Group, Dutch Sustainable Business (De Groene Zaak), the Ecologic Institute, the Institute for European Environmental Policy and UnternehmensGrün	Working to secure a European circular economy package that generates new jobs and revenues while driving product innovation, secondary raw material use and new business models
CHEM Trust (United Kingdom)	NGO aiming to prevent human-made chemicals from causing long-term damage to wildlife or human beings	Engagement with chemicals of concern in the circular economy
Circle Economy (Netherlands)	Social enterprise to accelerate the transition to circularity	Development of practical solutions, international communication and engagement
Circular Change (Slovenia)	Platform for stakeholder engagement focusing on the circular economy	Mission to inform, educate, recognize leaders, interpret best practice and co-create pioneering case studies in the transition from the linear to circular business models
Circular Economy Institute (France)	Aims to promote and accelerate the transition to the circular economy	Functions as a national multistakeholder think tank allowing the pooling of expertise and good practices
Circular Impacts (EU)	EU-funded research project involving the Ecologic Institute, the Centre for European Policy Studies and Wageningen Economic Research	Project measuring impacts of transition to the circular economy based on concrete data and macroeconomic, societal, environmental and labour market indicators

	Circular economy health-related activity	Key reports and websites
	Health issues not covered in the circular economy reports reviewed	Aldersgate Group (2017) Website (http://www.aldersgategroup.org.uk/blog/tag:circular-economy)
	Health issues not covered in the circular economy reports reviewed	ACES (2017) Website (http://www.green-alliance.org.uk/allIancefor_CEsolutions.php)
	Raising awareness of health/toxicity issues in the circular economy	Website (http://www.chemtrust.org.uk/home)
	No specific health focus but inclusion of health implications in case study on textiles	Website (http://www.circle-economy.com)
	No specific health focus among case studies	Website (http://www.circularchange.com)
	No specific health focus	Website (http://www.govsgocircular.com/cases/the-circular-economy-institute)
	Categorization of impacts includes health, although no detail yet available	Rizos et al. (2017) Website (http://circular-impacts.eu/start)

Organization/ Network	Description	Circular economy activities
Club of Rome (global)	Promotes understanding of global challenges and proposes solutions through scientific analysis, communication and advocacy, with a holistic, systemic and long-term perspective	Research on social benefits of the circular economy, particularly carbon emissions and employment
DAKOFA (Waste and Resource Network Denmark)	Primary task to prepare the Danish waste and resource sector for navigating in a dynamic society	Circular economy project that looks at opportunities from a country and policy-maker perspective
EMF (global)	NGO with mission to accelerate the transition to a circular economy	Global leader in placing the circular economy on the agenda of decision-makers across business, government and academe
European Commission (EC) (EU)	EU executive arm	Circular economy action plan
European Environment Agency (EU)	EU agency providing independent information on the environment	Publishing a series of circular economy reports
European Sustainable Business Federation (EU)	Network of national associations promoting sustainable economic policies	Promoting concepts and projects fostering the circular economy
Foundation for Circular Economy (Hungary)	Initiative to promote circular economy in Hungary and worldwide	Primary aim to create platform for knowledge, experience and practice related to circular economy
Friends of the Earth (global)	International NGO network campaigning on environmental issues	Part of group of NGOs lobbying EC circular economy plans
Green Alliance (United Kingdom)	Charity and independent think tank focused on leadership for the environment. Works with businesses, NGOs and politicians.	The Green Alliance convenes the Circular Economy Task Force: business-led group (including Waste and Resources Action Programme (see below)) that researches policy solutions to enable a more circular economy. The Green Alliance is a member of ACES.
Health and Environment Alliance (HEAL) (EU)	Non-profit-making organization addressing how the environment affects health in the EU	Part of group of organizations commenting on EU waste and circular economy policies
Mc Kinsey Center for Business and Environment (Global)	Centre intended to provide insights and solutions so that economies and the environment can thrive	Collaborating with EMF and the SUN Institute on, for example, circular economy report (EMF, 2015b)

	Circular economy health-related activity	Key reports and websites
	Health only indirectly referenced in circular economy reports through health impacts of unemployment and carbon emissions	Wijkman & Skånberg (2015, 2016) Website (https://www.clubofrome.org/a-new-club-of-rome-study-on-the-circular-economy-and-benefits-for-society)
	Link to case study on hospitals in Denmark given by EMF (2015a)	Website (https://dakofa.com/element/test-article-last-week)
	Estimates of reduced environmental and health externalities from the circular economy transition; some health implications analysis in sector reports, e.g. for food, mobility and built environment	EMF (2015b, 2017) Information website (http://circulatenews.org) Website (https://www.ellenmacarthurfoundation.org)
	Action plan acknowledges that actions should preserve a high level of protection of human health and environment.	EC (2015, 2017) Website (http://ec.europa.eu/environment/circular-economy/index_en.htm)
	Publications acknowledge importance of health protection.	Website (https://www.eea.europa.eu/publications/circular-economy-in-europe)
	No specific health focus	Website (https://ecopreneur.jimdo.com)
	No specific health focus	Website (http://circularfoundation.org/en)
	Health issues not a focus in the circular economy materials reviewed	Friends of the Earth Europe (FoEE, 2014) Website (https://www.foe.co.uk/page/what-circular-economy)
	–	Benton & Hazell (2013), Benton et al. (2015), Green Alliance (2015), Hislop & Hill (2011) Website (http://www.green-alliance.org.uk/resourcestewardship.php)
	Active in raising awareness of health issues (e.g. toxic substances, endocrine-disrupting chemicals) in the circular economy context	HEAL (2015) Website (http://www.env-health.org)
	Estimates of reduced environmental and health externalities from the circular economy transition in reports	Website (http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/europes-circular-economy-opportunity)

Organization/ Network	Description	Circular economy activities
REBus project (Netherlands and United Kingdom)	EU LIFE+ funded project pioneering resource-efficient business models (REBMs) for a circular economy	Set up to test the REBM methodology in a number of business case studies the Netherlands and the United Kingdom and promote the development of a circular economy
SUN Institute Environment & Sustainability	Supports institutions, programmes and projects on environmental challenges and opportunities of globalization and enhanced cross-border activities	Collaborating with EMF and the McKinsey Center on, for example, circular economy report (EMF, 2015b)
Think20 Circular Economy Task Force	Part of Think20 network of research institutes and think tanks from the Group of Twenty	Focuses on what Group of Twenty governments can do to accelerate the transition, transform value chains, and realize the benefits for society, the environment and the economy.
Waste and Resources Action Programme (WRAP) (United Kingdom)	NGO working with governments, businesses and communities to deliver practical solutions to improve resource efficiency	Broad range of activities for circular economy, including on resource efficiency, waste reduction, recycling and alternative business models; member of Circular Economy Task Force (see above)
World Economic Forum (global)	International organization for public–private cooperation	Launched Platform for Accelerating the Circular Economy, led by the Global Environment Facility, Royal Philips N.V. and United Nations Environment Programme (UNEP)
Zero Waste Europe	Knowledge network and advocacy group across the EU that promotes elimination of waste in society	Aims including to redesign relationship with resources, adapt consumption patterns and think circular

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Benton D, Hazell J (2013). Resource resilient United Kingdom, a report from the Circular Economy Task Force. London: Green Alliance.

Benton D, Coats E, Hazell J (2015). A circular economy for smart devices: opportunities in the US, United Kingdom and India. London: Green Alliance.

[23] Electronic references were accessed on 17 April 2018.

	Circular economy health-related activity	Key reports and websites
	Includes health care sector pilot projects for medical technology companies and medical centres	Website (http://www.rebus.eu.com)
	Estimates of reduced environmental and health externalities from the circular economy transition in reports	Website (https://www.sun-institute.org/en)
	No particular health focus	Website (http://www.t20germany.org/circular-economy)
	Health issues not covered in the circular economy material reviewed	Website (http://www.wrap.org.uk/about-us/about/wrap-and-circular-economy)
	Has no specific health focus, but has collaborated on EMF reports	Website (https://www.weforum.org/projects/circular-economy)
	Specific campaigning on issues of designing out toxic substances from products and bans on specific hazardous substances in EU	Website (https://www.zerowasteeurope.eu/category/waste/circular-economy)

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Wijkman A, Skånberg K (2015). The circular economy and benefits for society: jobs and climate clear winners in an economy based on renewable energy and resource efficiency: a study pertaining to Finland, France, the Netherlands, Spain and Sweden. Winterthur: Club of Rome.

Wijkman A, Skånberg K (2016). the circular economy and benefits for society: jobs and climate clear winners in an economy based on renewable energy and resource efficiency: a study pertaining to the Czech Republic and Poland. Winterthur: Club of Rome.

The WHO Regional
Office for Europe

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

Member States

Albania
Andorra
Armenia
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Belarus
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Czechia
Denmark
Estonia
Finland
France
Georgia
Germany
Greece
Hungary
Iceland
Ireland
Israel
Italy
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Luxembourg
Malta
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Montenegro
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World Health Organization Regional Office for Europe
UN City, Marmorvej 51, DK-2100 Copenhagen Ø, Denmark
Tel.: +45 45 33 70 00 Fax: +45 45 33 70 01
E-mail: contact@euro.who.int

Focus 7:

Global Initiatives and publications on Global Circular Value Chains and Trade

2023 Fiscal Review Committee:

Summary of relevant initiatives and publications on circular economy value chains and trade

To date, there are a number of relevant global initiatives and publications on the topic of global circular value chains and trade. Here's a list of sources identified for the session on Trade and Value Chains.

Global initiatives

SWITCH to Circular Economy Value Chains

Lead Organisation: UNIDO, in partnership with Chatham House, Circle Economy, European Investment Bank

Funded by: the European Union and the Government of Finland

Description: The SWITCH programme aims to support MSME (micro-, small-, and medium-sized) suppliers in developing countries in the value chains of large EU manufacturers and buyers to jointly identify, adopt and excel in circular economy practices.

The transition towards a circular economy is imperative to achieve economic, environmental and societal benefits which can significantly reduce poverty. SWITCH supports and facilitates effective and replicable pilot projects that involve all relevant actors across selected value chains and enable enterprises to meet their circularity goals.

Countries: Morocco, Bangladesh, Egypt

Partnership for Action on Green Economy (PAGE)

Lead organisation: United Nations

The Partnership for Action on Green Economy (PAGE) has grown into a prominent alliance of five UN agencies, 8 funding partners, and 22 partner countries that work together to transform economies into drivers of sustainability by supporting nations and regions in reframing economic policies and practices around sustainability. PAGE is increasingly recognized as a model to deliver coordinated support of UN to countries for achieving Sustainable Development Goals (SDGs) and targets of the Paris Agreement.

Countries: PAGE operates across 20 countries.

GOCircular Global Programme

Lead Organisation: GIZ

Description: The objective of the Go Circular global programme is to support the transition to a circular economy at the global level and in three partner countries: Colombia, Ghana and Vietnam. The global programme works in the following priority areas:

Promoting innovation: The programme advises public institutions, business associations and companies on innovative technologies and business models – for example, to increase the use of recycled material or to replace single-use packaging with reusable packaging in the hospitality sector. It holds innovation competitions to promote new approaches and ideas, with a particular focus on process innovation, for instance in the use of digital tools to track material flows. The priority area also works on innovative financing models such as circular impact bonds.

Scaling up solutions: Working with public and private actors, the global programme disseminates tried-and-tested solutions and adapts them to local contexts. Examples include systems for extended producer responsibility (EPR) and business models for recycling batteries, processing organic waste and avoiding packaging. The programme also provides advice on suitable promotion and financing concepts, carries out training measures and advises on adapting solutions.

Countries: Colombia, Ghana and Vietnam

Circularity Platform (with electronics as one of the key sectors)

Lead Organisation: UNEP

Description: This platform provides an understanding of the circularity concept, its scope and how it contributes to promoting sustainable consumption and production patterns.

Countries of focus: global

PREVENT Waste Alliance

Lead organisation: BMZ

Description: Initiated under the patronage of the German Development Minister Gerd Müller, the PREVENT Waste Alliance was launched in May 2019. It serves as a platform for exchange and international cooperation. Organisations from the private sector, academia, civil society and public institutions jointly engage for a circular economy.

The PREVENT Waste Alliance wants to contribute to minimising waste, eliminating pollutants and maximising the reuse of resources in the economy worldwide. Members of the platform work together for waste prevention, collection and recycling as well as the increased uptake of secondary resources in low- and middle-income countries.

The platform focuses on waste from plastic packaging and single use products as well as waste electrical and electronic equipment.

Countries: global

Global Alliance for Circular Economy and Resource Efficiency (GACERE)

Organisation: UNEP

Description: The Global Alliance on Circular Economy and Resource Efficiency (GACERE) is an alliance of governments willing to work together on and advocate for a global just circular economy transition and more sustainable management of natural resources at the political level and in multilateral fora. GACERE was launched in February 2021, in the margins of the first segment of the fifth United Nations Environment Assembly (UNEA-5.1).

Bringing together governments and relevant networks and organisations, GACERE aims to provide the global impetus for initiatives related to the circular economy transition, resource efficiency and sustainable consumption and production, building on efforts being deployed internationally.

Traceability for Sustainable Garment and Footwear

Lead Organisations: UNECE & ITC

Description: UNECE and UN/CEFACT work with key industry stakeholders in the garment and footwear industry. They tackle challenges and risks and have launched a project for an international framework initiative to enhance transparency and traceability for sustainable value chains.

Over the period 2019-2022 the project aims at setting up a multi-stakeholder policy platform, developing policy recommendation, traceability standards and implementation guidelines, and build capacity and conduct pilots on the project deliverables.

As part of that work, UNECE has launched “The Sustainability Pledge” inviting governments, garment and footwear manufacturers and industry stakeholders to pledge to apply their toolkit of measures and take a positive step towards improving the environmental and ethical credentials of the sector.

Global Battery Alliance

Lead organisation: Responsible Business Alliance

Description: The Global Battery Alliance (GBA) 2030 Vision is to foster a circular, responsible and just battery value chain, and is detailed in a foundational analytical report conducted by the GBA, the World Economic Forum, McKinsey & Co. and SYSTEMIQ. The GBA brings together leading international organisations, NGOs, industry actors, academics and multiple governments to align collectively in a pre-competitive approach to drive systemic change along the entire value chain. Incubated by the World Economic Forum in 2017 until its independence in 2021, members of the Alliance collaborate to achieve the goals set out in the GBA 2030 Vision and agree to the Ten GBA Guiding Principles. The GBA’s multi-stakeholder governance structure aims to ensure inclusivity in decision-making and strategic focus. Action Partnerships provide a collaborative platform for members to pool their expertise to achieve the shared goals of circularity, environmental protection and sustainable development.

Countries: global

Circular Electronics Partnership

Lead organisation: WBCSD

Description: The Circular Electronics Partnership (CEP) will unite leaders in tech, consumer goods and waste management to identify how to do things better. We aim to reimagine the value of electrical products and materials using a lifecycle approach, reducing waste from the design stage through to product use and recycling. Our vision includes all types of electronic and electrical equipment from six product categories: temperature exchange equipment, screens and monitors, lamps, large equipment and small IT items.

Countries: global

TESSD Informal Working Group on Circular Economy

Lead Organisation: WTO, supported by the Forum on Trade, Environment & the SDGs (TESS)

Description: The Trade and Environmental Sustainability Structured Discussions (TESSD) are intended to complement the work of the Committee on Trade and Environment and other relevant WTO bodies and to support the objectives of the Marrakesh Agreement Establishing the WTO, which envisages a global trading system that protects and preserves the environment in accordance with sustainable development. TESSD hosts several informal working groups including the group for circular economy which explores how trade can support the circular transition.

Sustainable Manufacturing and Environmental Pollution (SMEP)

Lead organisations: UNCTAD & FCDO

Description: The programme activities aim to generate cutting edge scientific evidence that can improve existing knowledge of the environmental health and socio-economic impacts of selected trade-exposed manufacturing sectors across target countries in Sub-Saharan Africa and South Asia. The programme will also identify suitable technology-based solutions to address the most pressing environmental health issues associated with manufacturing in the target countries, and invest in developing business processes and systems that will result in the uptake of pollution control solutions. In addition, the programme will address the issue of plastic pollution, focusing on identifying and supporting the development of solutions towards material substitution and enhanced biodegradation options.

Regional Initiatives

African Circular Economy Alliance

Members (currently): Rwanda, South Africa, Nigeria, Ghana, Côte d’Ivoire, Benin, Burkina Faso, and Sudan

Description: Conceived at the World Economic Forum on Africa in Kigali in 2016 and launched at COP 23 in Bonn, the African Circular Economy Alliance was founded by Rwanda, Nigeria and South Africa along with UN Environment and the World Economic Forum. The 17th Ordinary Session of the African Ministerial Conference on the Environment (AMCEN), which took place in Durban in November 2019, called for the widespread adoption of the circular economy on the continent. AMCEN is committed to replicate, scale-up and use circular approaches as part of Africa's transformation efforts, in line with African Union "Agenda 2063", and to support the work of the Alliance.

The Alliance is open to membership from national institutions and public sector entities, international organisations, funding institutions and research centres. Current member countries include Rwanda, South Africa and Nigeria, Ghana, Côte d'Ivoire, Benin, Burkina Faso, and Sudan. Current strategic partners include the African Development Bank, Africa Circular Economy Network, Global Environment Facility, Finland, PACE, UN Environment, UN Development Programme and World Economic Forum. Private sector membership will not be sought in the initial phase, although the Alliance will work closely with the private sector by way of consultation and collaboration on specific projects or activities.

Africa Circular Economy Facility (ACEF)

Lead organisation: African Development Bank

Description: The ACEF is the newest climate change initiative. It's the result of extensive negotiations between the Bank, the Government of Finland, the Finnish Innovation Fund Sitra and the Nordic Development Fund that were initiated at the World Circular Economy Forum 2019 in Helsinki, Finland.

This strategic partnership will enable the creation of a €4 million Multi-Donor Trust Fund at the Bank to support a five-year continental programme (2021-2025) dedicated to creating a fertile ground for the diffusion of circular practices in regional member countries. The ACEF will operate at both the continental and national levels, and will focus on three intervention areas to build the case for the circular economy through: 1) institutional capacity building for the creation of enabling environments necessary for whole-of-society transformation to enable the uptake of circular innovations and practices, 2) private sector support through a differentiated business skills development programme for start-ups and SMEs in the circular economy, and 3) promotion of country ownership by strengthening the African Circular Economy Alliance (ACEA).

Circular Economy Approaches for the Electronics sector in Nigeria

Organisations: UNEP, National Environmental Standards and Regulations Enforcement Agency of Nigeria (NESREA)

Description: The $15-million project brings together players along the electronics value chain (from government, the private sector and civil society) to kickstart a financially self-sustaining circular economy approach for electronics in Nigeria, protecting the environment while creating safe employment for thousands of Nigerians. It also connects with stakeholders along the global electronics value chain to bring forward recommendations on product design for circularity. The initiative is designed to transform the challenge of dealing with growing electronics waste and aims to promote a circular economy for electronics in Nigeria in which the electronics sector recovers and reintroduces usable materials into the value chain and disposes of hazardous waste streams in an environmentally sound manner.

Circular Economy Coalition for Latin American and Caribbean

Description: The Coalition will support access to financing by governments and the private sector, with special emphasis on small- and medium-sized enterprises (SMEs), in order to promote resource mobilisation for innovation and the implementation of specific projects in the region.

Coordinated by UNEP, the Coalition will be led by a steering committee composed of four high-level government representatives on a rotating basis, starting with Colombia, Costa Rica, the Dominican Republic and Perú for the 2021-2022 period.

Framework for Circular Economy for the ASEAN Economic Community

Lead Organisation: ASEAN Secretariat

Description: The Framework for Circular Economy for the ASEAN Economic Community provides a structured pathway for stakeholders to progressively adopt the circular economy model in achieving the sustainable economic development objective under the AEC Blueprint 2025. The Framework is ASEAN’s first strategic move towards promoting circularity for long-term resilience. It sets out an ambitious long-term vision of the circular economy, building on the strengths of existing ASEAN initiatives, and identifies priority focus areas for action along with enablers, to accelerate the realisation of circularity in ASEAN.

SWITCH-Med

Lead organisations: Implemented by the United Nations Industrial Development Organization (UNIDO), the United Nations Environment Programme (UNEP) Economy Division, and MedWaves, the United Nations Environment Programme Mediterranean Action Plan (UNEP/MAP) regional activity centre for Sustainable Consumption and Production (formerly known as SCP/RAC).

Description: Through policy development, demonstration activities and networking opportunities, SwitchMed supports and connects stakeholders to scale-up eco and social innovations. The programme supports policy makers, eco-innovative small- and medium-sized enterprises, industries, start-ups and entrepreneurs in the Southern Mediterranean countries, which have identified job creation and natural resource protection as priority issues that also contribute to their economic stability.

Countries: Algeria, Egypt, Israel, Jordan, Lebanon Morocco, Palestine and Tunisia.

SWITCH-Asia

Description: Launched in 2007, its SWITCH-Asia programme has achieved more than a decade of progress on SCP in 24 countries in the region. To support the transition of Asian Countries to a low-carbon, resource-efficient and circular economy while promoting sustainable production and consumption patterns within Asia and greener supply chains between Asia and Europe. Nearly €300 million invested towards promoting sustainable consumption and production (SCP) in Asia and Central Asia. 143 projects funded in the region over a period of 15 years of which 16 new ones active as of 2022.

SWITCH-Africa

Lead organisation: UNEP

Description: SWITCH Africa Green is a programme developed in 2013 to support countries in Africa in achieving sustainable development by transitioning to an SCP-based inclusive green economy. It provides opportunities for the private sector to move to more resource-efficient, environmentally sound business practices that also increase profitability, create green jobs and reduce poverty.

List of Publications

Trade for an inclusive circular economy: A framework for collective action

Authors: Chatham House, IEEP, ACEA, Circular Economy Coalition for Latin America and Caribbean, UNIDO

Description: Circular trade is a key enabler of a global circular economy, but inequities in power relations, digital trade capabilities, trade infrastructure, access to finance and industrial and innovation capabilities mean that countries in the Global North are better positioned to reap the benefits than are those in the Global South. If an explicit goal to reduce inequality is not built into the global circular economy transition, the gains to be made from circular trade are likely to be highly unevenly distributed between developed and least developed countries.

This paper sets out a framework for inclusive circular trade, intended to enable a pathway in which circular trade helps to promote fair, inclusive and circular societies. The framework was developed through the work of an alliance of organisations spanning Africa, Southeast Asia, Latin America and the Caribbean, and Europe.

The role of international trade in realizing an inclusive circular economy

Author: Chatham House

Description: The transition to a circular economy is essential to address the triple threat of pollution, climate change and biodiversity loss. International trade will play a key role in delivering this transition, as no single country can achieve a circular economy alone. Currently, the distribution of value from circular trade is highly uneven, with the Global North accruing most of the economic gains while the Global South bears most of the environmental and human costs. Greater collaboration at the global level is therefore necessary to prevent the development of a circular trade divide.

Despite the importance of the circular economy in achieving global environmental and human development goals, there remains limited awareness or understanding among trade actors. To address this knowledge gap, this research paper presents a working definition of circular trade and outlines the main types of circular trade flow in goods, services, materials and intellectual property. The paper then explores the main benefits and challenges of each flow, before proposing a pathway to collective action to ensure that global trade enables fair, inclusive and circular societies.

Towards a Circular Economy for the Electronics Sector in Africa: Overview, Actions and Recommendations

Author: United Nations Environment Programme (UNEP)

Description: This report provides an overview of the current state of circularity in the electronics value chain in Africa, identifies key areas of concern, provides appropriate recommendations and proposes priority actions to improve circularity in the sector. The recommendations focus on the individual life cycle stages of the electronics value chain, as well as on aspects that cut across the value chain. The transition towards a more circular electronics sector in Africa would require a holistic, coordinated approach bridging six key knowledge areas covering policy and governance, innovation, technology and infrastructure, capacity development, and financing. The report also proposes a list of priority actions to be taken by a variety of key stakeholders, including policymakers, businesses, civil society groups, researchers, etc. While an attempt has been made to identify the most relevant actions and tailor them to the African region, the list is not exhaustive and proposed actions may also be applicable elsewhere.

Exploring the global environmental and socio-economic effects of pursuing a circular economy

Authors: Circle Economy and PBL Netherlands Environmental Assessment Agency

Description: During 2019, Circle Economy conducted a study commissioned by the Netherlands Environmental Assessment Agency on the Global environmental and socio-economic effects of pursuing a circular economy in the Netherlands and the EU. The scope of the study is exploring impacts in low-income countries. The study provides a deep dive into two exemplary products (denim jeans and mobile phones) with globalised value chains (both upstream and downstream) and significant potential for circular economy initiatives. From resource extraction to end-of-life, the study visualises and highlights the most important countries involved in these value chains. It also describes the potential impacts of Dutch and EU circular economy policies on countries outside the EU by looking at indicators such as land use, pollution of water and soil, work and income, CO2 emissions, and health and safety.

Trading Services for a Circular Economy

Authors: Sitra and IISD

Description: This joint report by IISD and the Finnish Innovation Fund Sitra reviews the role that services play in supporting circular economy business models and draws on new empirical research in the form of a survey and set of interviews to identify how firms buy and sell services to support their circular economy activities and the extent to which they buy and sell these services internationally. In addition, it reviews the impact of digitalisation on services and services trade and how this relates to the transition to a more circular economy.

International trade and circular economy – Policy alignment

Author: OECD

Description: This report explores how to make circular economy policies and trade policies mutually supportive by mapping out potential misalignments and identifying opportunities to align and strengthen both policy areas. The report highlights the various interlinkages between international trade and circular economy, and examines the interactions between trade and circular economy at the policy level, focussing on the multilateral trade regime and regional trade agreements, as well as specific policies to promote the circular economy, such as extended producer responsibility and product stewardship schemes, taxes and subsidies, green public procurement, environmental labelling schemes and standards.

EU Circular Economy and Trade

Author: IEEP

Description: The report examines the foreseen impacts of implementing circular economy measures in the EU on international trade and – through trade – on third countries. A number of policy recommendations are provided, calling for improved policy coherence between circular economy measures and trade policies.

Trade policies for a circular economy: what can we learn from WTO experience?

Author: WTO

Description: This paper reviews work at the WTO related to the circular economy. It shows how WTO members have addressed issues related to the circular economy through policy dialogue, peer review, negotiations and more recently, Aid for Trade. Experience in these four areas provides valuable insights into how WTO members can expand the positive contribution of trade to a circular economy, not least by: 1) improving their collective understanding of how trade interacts with the circular economy; 2) building trust and confidence to engage in mutually beneficial activities related to the circular economy; 3) opening and facilitating trade in key areas of the circular economy; and 4) supporting efforts in developing countries to seize the potential environmental, economic and social benefits of a circular economy through enhanced trade.

The Circular Economy, Trade, and Development: Addressing spillovers and leveraging opportunities

Author: TULIP Consulting, 2020

Description: This paper aims to obtain a clearer understanding of the linkages between the circular economy, trade and development, and the various tools available to developing economies to leverage opportunities and mitigate any negative spillovers.

Circular Innovation and Ecodesign in the textiles sector: Towards a sustainable and inclusive transition

Author: Sitra & TULIP Consulting

Description: This report provides analysis and vision for how trade arrangements with the EU could be leveraged to support the transition, offering producer countries targeted technical support and investment while minimising the risk of new trade barriers. Producer-country governments, as well as the private sector, will also play key roles.

Promoting a Just Transition to an Inclusive Circular Economy

Author: Chatham House

Description: This paper first introduces the relevance of the circular economy in the international development and SDG context. It then sets out the just transition approach, and its relevance in climate change and energy transition debates. The paper then explores how the just transition approach can be successfully applied in the circular economy context. Three examples from the priority sectors and value chains of metals, mining and electronics; the textile and fashion sector; and waste management and plastic recycling highlight the potential negative transition impacts and opportunities for just transition approaches. The roles of policy, finance and international trade are outlined as means of steering the transition from linear to circular in an inclusive manner. In conclusion, the paper offers recommendations for policymakers, business leaders, academics and social entrepreneurs on how to advance a just circular economy transition at the national and international levels.

Options to Incorporate Circular Economy Provisions in Regional Trade Agreements

Author: IISD

Description: This report explores ways in which trade policy can further support a transition to a more circular economy using regional trade agreements (RTAs) as a vehicle. In doing so, it suggests possible options to incorporate circular economy-related provisions in future RTAs, building on precedents with similar objectives in agreements currently in force or under negotiation.

Sustainable trade in resources: Global material flows, circularity and trade

Author: UNEP IRP

Description: The purpose of this discussion paper is to enhance understanding among trade and environment policymakers regarding trade flows of material resources – including their environmental impacts – and regarding trade's potential to contribute to the transition to a greener, more circular economy. The paper summarises the IRP's analysis on so-called upstream requirements of trade flows, drawing on the IRP reports International Trade in Resources (2015), Global Material Flows and Resource Productivity (2016), Sustainable Natural Resource Use (2017) and Global Resources Outlook (2019). The paper builds on the work of UNEP's Environment and Trade Hub to offer policy implications focusing on the role of trade in moving production and consumption away from linear to more circular models.

The Consequences of a more resource efficient and circular economy for international trade patterns: a modelling assessment

Author: OECD

Description: This report investigates the effects of a resource efficiency and circular economy transition on international trade flows, using the OECD's ENV-Linkages model. A global policy package will cause secondary materials to become cheaper, while primary materials become more expensive to produce. By 2040, primary non-ferrous metals are projected to decline by 35-50%, primary iron & steel by 15% and primary non-metallic minerals by around 10%. Regional shifts in production and trade-related effects (shifts in the regional sourcing of the primary materials by the materials processing sectors) account for roughly one-third of the total reduction in materials use. The other two thirds of materials use reduction come from scale effects (reduced economic activity) and efficiency effects (reduced materials use per unit of output of the processed commodities).

Potential effects of Dutch circular economy strategies on low- and middle-income countries: the case of electrical and electronic equipment

Author: PBL Netherlands Environmental Assessment Agency

Description: The Netherlands has the ambition to achieve a fully circular economy by 2050. This report analyses what such a transition could mean for low- and middle-income countries that are connected to the Netherlands through international value chains, focusing on transboundary trade in discarded electrical and electronic equipment. It identifies conditions for positive impact and discuss opportunities, risks and dilemmas. This study is part of a broader project that analyses transboundary effects of the circular economy transition in the Netherlands.

Improving resource efficiency and the circularity of economies for a greener world

Author: OECD

Description: Global demand for materials has been growing over the past century, driven by steady economic growth in OECD countries, the industrialisation of emerging economies and a growing world population. At the global level, materials use more than doubled between 1990 and 2017, and it is projected to double again by 2060. Due to the growing amounts of materials use, environmental pressures such as land degradation, greenhouse gas emissions and the dispersion of toxic substances in the environment are projected to more than double in the decades to come. In this context, improving resource efficiency and stimulating the transition towards a more circular economy has become crucial. In recent years an increasing number of governments have started implementing policies and strategies to meet this objective, but stronger efforts are needed to significantly improve the sustainability of materials management and the circularity of economies across the world.

Plastics, the Circular Economy and Global Trade

Author: World Economic Forum

Description: This briefing note draws on the expertise of trade and environment experts from across the plastics value chain to identify the key cross-border challenges to scaling a more circular economy for plastics. It also provides basic trade and investment solutions for tackling these challenges and opens the door for further multistakeholder collaboration to build a sustainable circular plastics economy.

Understanding the Future of Canada-UK Trade Relationships in a Circular Economy Context

Authors: Lange D de, Walsh P, Sheeran P

Description: Through a literature review focusing on academic journal articles, this report investigates existing trade theory and trade agreements regarding circular economy principles to inform the design and implementation of future trade agreements between Canada and the UK, post-Brexit. This report identifies gaps in that knowledge base and recommends future research that may facilitate Canada-UK circular economy trade.

International Trade and the Transition to a More Resource Efficient and Circular Economy – Concept Paper

Author: OECD

Description: The transition towards a more resource efficient and circular economy has broad linkages with international trade through the emergence of global value chains as well as trade in second-hand goods, end-of-life products, secondary materials and waste. Despite the potential linkages between trade and the circular economy, to date the existing research on this issue is limited. For this reason, this paper highlights the potential interaction of international trade and the circular economy in order to map out potential issues to address and to guide further research areas to explore on this topic. The paper briefly introduces the circular economy concept and how trade can come into play, highlights the various ways in which trade and the circular economy can potentially interact with one another, and briefly concludes with potential ways forward and next steps.

Universal circular economy policy goals

Author: Ellen MacArthur Foundation

Description: The Ellen MacArthur Foundation has set out five universal circular economy policy goals that provide a framework for national governments, cities and businesses to create a transition that fosters innovation and decouples growth from finite resource consumption and environmental degradation. These goals are to: stimulate circular design; manage resources to preserve value; make the economics work; invest in innovation, infrastructure and skills; and collaborate for systems change.

The Circular Economy and International Trade: Options for the World Trade Organization

Author: International Chamber of Commerce

Description: As a contribution to this emerging field of research, this report reviews the main findings of existing literature and supplements it with qualitative insights from interviews with trade policy makers, researchers in non-government organisations, private sector firms operating in different segments of circular economy value chains, and international organisations focused on different aspects of the circular economy. It starts with a short description of the circular economy as a concept, before reviewing the role of international trade in facilitating a transition to a more circular economy. In doing so it explores in particular the role of multilateral institutions and trade policy frameworks, such as the World Trade Organization (WTO), and provides specific recommendations for action.

The EU's circular economy transition for plastics and textiles: opportunities and challenges for trade partners in emerging markets

Author: Chatham House

Description: As the circular economy agenda moves forward, through policies and industry initiatives in consumer countries, there is a risk that it will create trade barriers for developing country producers. At the same time, there is a huge opportunity for producers who adopt circular strategies to become favoured suppliers in certain high value market segments. Developing country producers that implement a circular production strategy can both manage their environmental impacts and stay competitive in greening export markets. This paper assesses how EU policy is accelerating the circular economy transition, what implications this will have for global value chains, and how developing country producers may navigate changing markets.

The publication is prepared under the Switch to Circular Economy Value Chains, project co-funded by the EU and Government of Finland, and led by UNIDO in partnership with Chatham House, Circle Economy and European Investment Bank.

Focus 8:

The role of Design in the Circular Economy

2023 Fiscal Review Committee:

Report 01: June 2013

Investigating the role of design in the circular economy

THE GREAT RECOVERY
REDESIGNING THE FUTURE

RSA
Action and Research Centre

Contents

Businesses who want to be profitable, innovative and progressive will look to reduce the volumes of waste they produce, will think about the way their products are made and distributed, and what happens to them when they reach their end of life.

Government Review of Waste Policy in England 2011, Defra

Executive Summary

> The Great Recovery project, launched in September 2012 by the Action and Research Centre at the RSA, aims to build a cross disciplinary design community that is equipped to support the development of an economy based on resource-efficient principles.

> Waste & Resources Action Programme (WRAP) estimates that around 540m tonnes of products and materials enter the UK economy each year but only 117m tonnes of this gets recycled. Redesigning our manufacturing processes around circular economy principles will increase reuse and recycling, create new business opportunities, address material security issues and contribute to sustainable economic growth.

> We have created a network of professionals involved in all parts of the lifecycle of products in our economy, and engaged them in rethinking the design of these products from a circular perspective.

> The Great Recovery has run a programme of workshops, networking and brokering events, presentations, debates and round tables. These have helped build understanding around the principles of closed loop design and the barriers to achieving full circularity.

> These events have supported Technology Strategy Board's (TSB) 'New Designs for a Circular Economy' competition that has invested £1.25m to 35 cross-disciplinary teams to carry out feasibility studies across a wide range of products and processes.

> We have developed an online resource that focuses on design for a circular economy. This includes a growing database of reports, images and information, articles, blogs, Twitter feeds and a dedicated YouTube channel which hosts films of the workshops.

Through the circular network, workshops and teardown observations, we have gained a better understanding of what action and research is required to transform the way society manages resources. We have made a series of key recommendations based on the findings of the first phase of The Great Recovery programme.

Key recommendations:	Actions:
1. Skilling up the design industry	
Prepare future generations of designers. Embed circularity in the design education system. Sustainable design must not continue to be left behind or added as a last minute thought. Make sustainability a matriculation criterion in every design and engineering degree. Encourage multi-disciplinary learning based on an understanding of the lifecycle of the products and services that we create.	Develop further and higher education modules to integrate design for circular economy and systems thinking into a wide range of design curricula. Develop an education programme that encourages cross-curricular learning, connecting designers with engineers, material scientists, anthropologists, marketeers and business students.
2. New Business approaches	
Redesigning the brief. Businesses must begin to develop design briefs around new business models that take account of provenance, longevity, impact and end-of-life. They must consider a circular approach.	Help businesses to develop briefs that incorporate resource efficiency and closed loop principles. Support the commissioning of effective design that incorporates circular economy principles. Broker new dialogues between the designers, suppliers and the waste industries to instigate new collaborations for innovation around end-of-life, with an initial focus on packaging.
3. Networks: connecting and collaborating	
Create access to new spaces that allow collaborative R&D for businesses and their supply chains to test, trial and design around circular principles and the four design models; design for longevity, design for leasing/service, design for re-use in manufacture, design for material recovery.	Create a physical space where industry stakeholders can come together to test product, systems and service design, supported by a network of expert consultants. Develop design standards and tools to support closed loop design and continue to build the online library of open source information about closed loop design and the circular economy.
4. Pushing the policy	
Multi-layered packaging which prevents or increases the complexity and cost of recycling should be designed out. At the same time, investment in innovation into fully recoverable mono-material packaging should be supported to increase greater resource recovery.	Open up dialogue with government around new legislation to encourage packaging design for full recoverability. Encourage companies to provide full operating and repair manuals for all electronic products. Enable discussions with the *Circular Network* and government which investigate the legislative barriers involved in moving to a circular economy.

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Introduction to The Great Recovery

What is The Great Recovery?

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Design will play a key role in the transition to a circular economy. We need to educate and inspire the design industry to take up this challenge.

Sophie Thomas
Project Director, The Great Recovery

The Great Recovery is a two year project run by the Action and Research Centre at the RSA and supported by the Technology Strategy Board.

Its aim is to build a cross disciplinary design community to drive forward a new resource efficient economy. It will do this by: raising the awareness of issues around increased resource scarcity, building up understanding in the principles of closed loop design, and fostering ideas and exploring new opportunities through collaborative partnerships in the wider supply chain network.

Since its launch in September 2012 The Great Recovery project has delivered a programme of hands on workshops, brokering events and presentations, debates and round table discussions. These have supported the competition 'New designs for a circular economy', led by the Technology Strategy Board. Their initial investment of £1.25m looked into new design and business collaborations which re-think products, components and systems that 'close the loop'.

This report reviews the first six months of the programme and makes a number of observations and proposes recommendations.

The Investor

John Whittall, TSB Lead Technologist, Resource Efficiency.

The TSB have understood for sometime the importance of design, but for me the key moment came about two years ago when I saw Sophie Thomas give an inspirational talk on how very often we design products with scant regard for what happens when we no longer want them.

She used lots of dramatic images on the consequences of such short-term thinking – piles of plastic waste accumulating on beaches after being concentrated by ocean currents, the persistence of everyday items in the environment long after we have finished with them – and the key message was that waste is design gone wrong.

For TSB it's all about generating long-term wealth for the UK. Yes, these issues are seen by many as environmental or societal problems, but we believe the way to address them at scale is to bring businesses to the table, articulate the opportunity and give them the tools and connections they need to make change happen.

The UK is well placed with many good eco-design practitioners, but at present it seems to be a niche activity. If we could mobilise the broader design community so that eco-design principles become embedded into good design practices that would be a real win. We have a world-class design sector in the UK and working with the RSA is a great way to reach out to this community.

The 'Government Review of Waste Policy in England, 2011' deemed the current levels of virgin raw-material usage in the UK manufacturing industry to be unsustainable.[1] Like many developed countries, the UK economy is highly dependent on several finite materials, and resource security is a growing concern. Nearly a third of profit warnings issued by FTSE 350 companies in 2011 were attributed to rising resource prices.[2]

Waste & Resources Action Programme (WRAP) estimates that around 540m tonnes of products and materials enter the UK economy each year but only 117m tonnes of this gets recycled. While there have been significant improvements in the UK's recycling rates in the past decade, we are still losing valuable streams of resource into landfill.[3]

The economic vulnerability of this situation indicates that current linear manufacturing models of 'take-make-dispose' (defined as taking raw material out of the ground, making products for consumption and disposing of these after use in a way that loses the resource) are not sustainable and a more circular system could bring stability and further economic opportunity. This model keeps valuable materials in the system by designing products that can adapt and are built to last. This may seem like a big challenge for business but could represent huge opportunities. In WRAP's 'Vision for the UK circular economy in 2020' it estimates that UK business could benefit by up to £23bn a year through such efficiencies in resource use.[4]

While our current crisis in resource management develops, society at large seems to have very little knowledge of, or interest in, what goes into making products that people consume daily. This 'ecological rucksack' of materials used to make a product can often be staggering. Innocuous objects such as plastic toothbrushes are heavier than expected, with more than 1.5kg of raw material used in production. Even a simple A4 piece of white paper can require 10 litres of water to produce.[5]

Generally, in manufacturing, 90 percent of the raw materials which go into making durable products become waste even before the product leaves the factory, and approximately 80 percent of what is made gets thrown away within the first 6 months of life.[6]

Take the mobile phone as another example. In 2011, the UK had over 80m mobile phone subscriptions, with 1,000 mobile phone replacements sold every hour. At

The Service Designer

James Rock
Managing Director, Design Thinkers.

When I started my career, the UK was a manufacturing economy. Now the UK doesn't manufacture so many products and we're essentially a service economy. Service design is really in its infancy. Many design schools still aren't teaching service design and most service designers are only in their twenties.

After World War II, America had excess manufacturing capacity and it had to develop a market for that manufacturing capacity. That's how marketing began, that's how graphic design began, that's how commercial TV began, because it was all about promoting the capacity of manufacturers to deliver products. From that we ended up with our consumer society.

China have been soaking up our manufacturing requirements with their low cost manufacturing capacity. They have a growing middle class and are now developing their own markets. In the UK, Europe and North America we have a situation where 78 percent of our economy measured by GDP is in services and 91 percent of employment is in services. It's therefore not surprising that we're using new service design tools to bring innovation.

the same time, an estimated 80m mobile phones that still worked but were not in use were retained in UK households, lost or forgotten in drawers and cupboards.[7]

While figures build an astonishing picture of consumption, there are even more extraordinary calculations to make when looking at what goes into making these popular devices. Every mobile phone is made from approximately 40 different elements, including copper in the wiring, indium in the touchscreen and gold in the circuit boards. It is estimated there is five times more gold in a tonne of electronic waste than there is in a tonne of mined ore from a gold mine.[8] As the price of metals and minerals rises, it makes increasing financial sense to recover these elements.

Between now and 2020, WRAP estimates that electronic waste in the UK will total more than 12m tonnes. Within this waste stream there will be numerous precious raw materials, which at the time of writing, have a total estimated market value of £7bn.[9] Of the 30 percent of e-waste that actually makes it to a recovery facility, most is crushed, sorted and exported, not just to countries that have established recovery industries but also to those that have more informal ones.

Revolutionary technologies such as smart phones are undoubtedly great assets in our daily lives and yet the shadow these devices leave behind tell stories of war and conflict, resource depletion and scarcity, environmental damage, water and energy use. It is the kind of complexity those working towards a circular economy will regularly face. The crux of the argument is the need for a manufacturing industry that is fit for purpose and a design industry that prioritises resource as value. It is unacceptable in the 21st century that the industrial world is operating through an ad-hoc system based on old and merged industrial revolution models.

The acceleration of consumer culture, particularly over the last 60 years, and even more dramatically in the last 20 years thanks to technological change, has resulted not in systemic thinking but in constant adaptations and add-ons to existing systems which, like a building covered in dodgy builder's extensions, has become almost unrecognisable as a result. The original architect of a system cannot be identified due to constant re-iteration over time.

Industrialists may think they are working with the most up to date technology and fully optimised systems, and by some definitions they are. However, if the layers are peeled back they reveal real horrors: hazardous factories in developing countries producing our cheap clothes; mines that contaminate land while fuelling conflict; and unstable systems built on slave labour, accidental deaths. These now antiquated foundations do not work for the triple bottom line of people, planet and profit.

The business opportunity of moving to a more circular system has now been well proven. The Ellen MacArthur Foundation/McKinsey report 'Towards

a Circular Economy' made the case that the EU manufacturing sector could realise resource savings worth up to $630bn a year if they made the transition, stimulating economic activity in the areas of product development, remanufacturing and refurbishment.[10]

The Great Recovery has set out on a journey to investigate the role of design in this new resource efficient economy. With an ambitious tagline: 'Redesigning the Future', the project aims to highlight the pivotal role of the designer in shifting systemic behaviours. Many government and NGO reports around resource scarcity cited design as the solution, the key in fact, in moving towards a circular, more self-reliant system. Pockets of designers have heard this but the reach has not been widespread. According to research done by the Design Council, approximately 80 percent of a product's environmental impact is 'locked in' at the concept design stage,[11] making a clear case for the major part that design needs to play, not just at the product efficiency level but at a system level and the very core of business re-structure. And as such, the first phase of The Great Recovery places emphasis on proper engagement with the design community and linking it to the supply and recovery network.

During the first phase of the project, a series of demonstration workshops were run, bringing sectors together to look at the common problems. Many of the events were hosted at material recovery centres, where attendees explored how 'problem products' could be better designed. The workshop started where problems currently end up, either thrown away or recovered to the best of our physical and technological abilities.

An online resource has been established with an extensive archive of reports and resources around the subject of the circular economy. All the workshops and events were filmed and have been watched by over 11,000 people on our dedicated YouTube channel. Guest articles, blogs and visual references have made The Great Recovery website a destination for those that are interested in circular design.

> Greater collaboration throughout the supply chain will ensure that all views and concerns from different sectors can be recognised, and solutions can be developed.
>
> Laura Wilton
> Policy Connect

The Material Expert

Rob Ireson
Innovation Team Leader at
Glass Technology Services.

The key thing was the chance to think about the full lifecycle of things, the different processes that are out there and the amount of dead materials that sit in people's drawers. It's also been a good opportunity to network.

One of the things we've realised in our company is that we have good links with the manufacturing sector and we're linked with the British Glass Trade Association. We've got good links with the retail people and people like the brewers and the distillers. But, we don't have particularly good links with people who actually design products. I've realised today that we actually need to develop those links with the designers who might use glass in their products to see if we can support them or inspire them.

The Maker/Fixer

Kyle Weins
Founder, iFixit and Dozuki.

We live in an age where information is at our fingertips – 24 hours a day, 7 days a week. Want to learn how to build a deck, make a robot, or program a computer? You can find that information for free on the web. Unfortunately, the flow of information stops when it comes to fixing what you own. Under the cloak of copyright, manufacturers have been able to keep critical service information and repair documentation under lock-and-key.

Keeping repair manuals off the internet shortens the life of a product. It ensures that most consumers won't be able to fix what they own. Instead, consumers are forced to send broken devices back to high-priced, manufacturer-authorised service centres. Repair costs can be exorbitant – especially for complex electronics, like cell phones. It's often easier and cheaper to just buy a new one. The old stuff gets thrown away.

Service and repair information needs to be free. The world desperately needs to know how to fix these products. Electronics repair is critically needed to solve the e-waste crisis; it helps bridge the digital divide by keeping secondhand electronics and developing countries' markets alive; and it accounts for hundreds of thousands of jobs in the United States alone.

Throughout the programme, feedback from participants was collected to help understand the problems and identify opportunities and challenges. This information is now being used to develop new work streams, test tools and new design systems, and build industrial-education programmes.

Future phases will take the lessons learnt to businesses, the government, education and, ultimately, consumers. This will ensure that everyone who has a role or an influence in the lifecycle of a product understands how they can play their part in redesigning the future.

> How do we keep the value of all these high-risk materials and the benefits they will have, both economically and in terms of remanufacturing jobs created and export potential associated with those industries within the UK economy?
>
> Andrew Raingold
> The Aldersgate Group

Mapping the making of a laptop – Mark Shayler

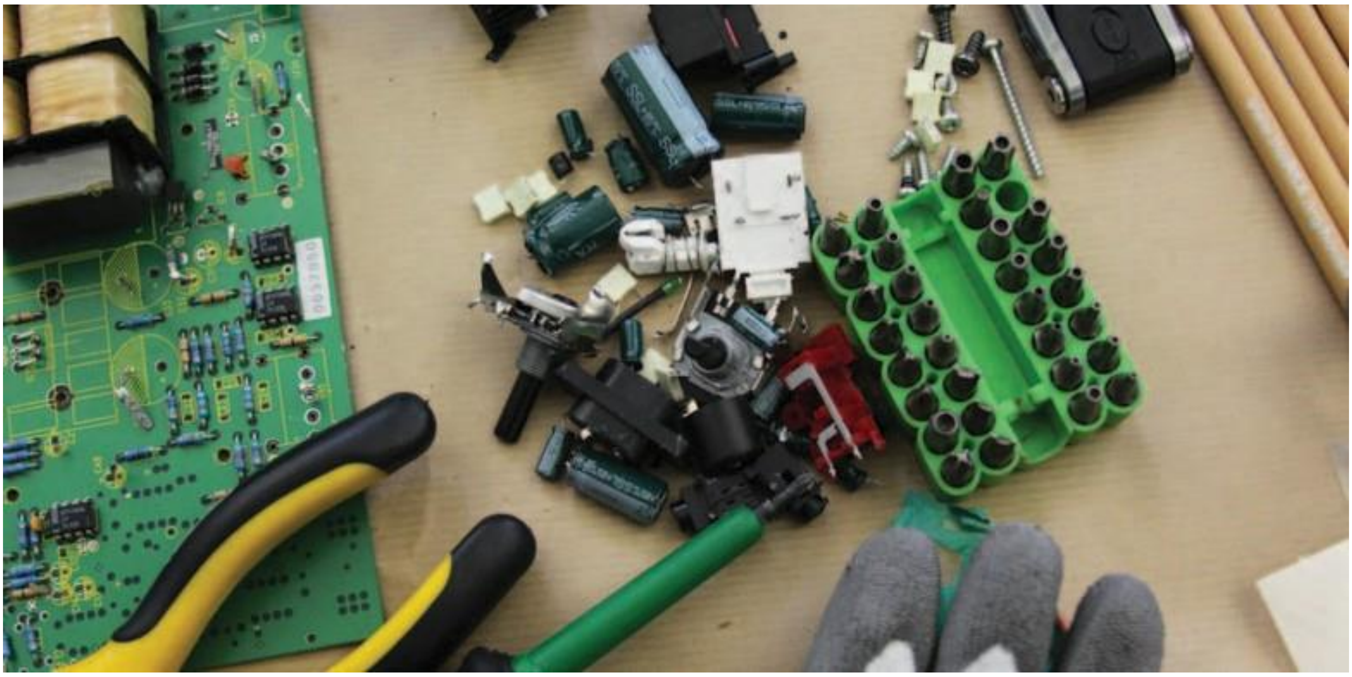
It is possible to map the complexity of supply chains through the movement of just one laptop's component – the valuable mineral ore called COLTAN (columbite tantalum). When refined, COLTAN gives us metallic tantalum, a heat-resistant powder that can hold a high electrical charge. This is used to make tantalum capacitors, which are used in most electronic products on the planet.

One of the sources for this mineral is the Democratic Republic of the Congo (DRC).[12] Somewhere between 14 and 64 percent of the world's COLTAN comes from the DRC.[13] Its neighbours sell COLTAN even though the mineral doesn't naturally occur there, and as markets are unregulated, it is impossible to accurately measure the quantities of COLTAN coming out of the DRC.

The COLTAN goes on a convoluted journey before ending up inside a laptop. From DRC it is sent to Japan to be processed, then on to Taiwan to be manufactured into capacitors. These are then shipped to China where they are assembled onto circuit boards with other components from around the world.

An amazing variety of elements are needed – other rare earth metals, flame-retardants, Teflon, copper, tin, gold, copper, acetone, nickel, platinum, chromium, to name just a few. Tracking where these come from is nearly impossible, the majority come from Africa, South America, Russia, and Australia.

The manufacture and processing of electronics also uses a significant amount of water and energy.[14] The packaging materials that are wrapped around all the sub-assemblies and products can't be forgotten either. Finally when the laptop is fully assembled and packaged it will be shipped or flown to its final destination and delivered to our homes.



The Design Student

Chloe Tuck
Industrial Design Student, Loughborough University.

I've always been interested in sustainability. I think design is crucial in its implementation. And it all starts with design. What you decide at the beginning determines a product's end. We have learned if you change something at the design stage it'll cost you 10p in a pound, but if you change something at the manufacturing phase it will cost hundreds of pounds. It shows how a tiny change at the beginning can impact so much at the end.

For example, we learned at Closed Loop if you cover the whole milk bottle label in glue rather than just one strip it causes problems in the whole recycling process. It's tiny things like that, that have such a big impact. A lot of it seems like common sense. Sustainability is a really crucial part of design now, rather than just an after thought. It's something that needs to be fully considered at the very beginning.

There isn't as much closed loop thinking in design education as there should be. In the first year we did some projects similar to this where we stripped down an electric shaver and had a look at the components. But it's not as ingrained in the course as it should be. In the second year you aren't exposed to any kind of sustainable legislation unless you choose that option module. You aren't going to be that informed about unless you take a particular interest in it. I think all designers should take an interest in it because it's so crucial to what we're doing.

2

Teardown, Build Up – The Workshop Process

Community and Network

“

Designers are excellent problem solvers, but we’re giving them the wrong problems to solve.

Mark Shayler
Ticketyboo

In the first phase of the project we have focused on building connections within the design and manufacturing community through a programme of events around the country. This process began with the mapping of different groups involved in the creation and use of a designed product or service; we call this the Circular Network.

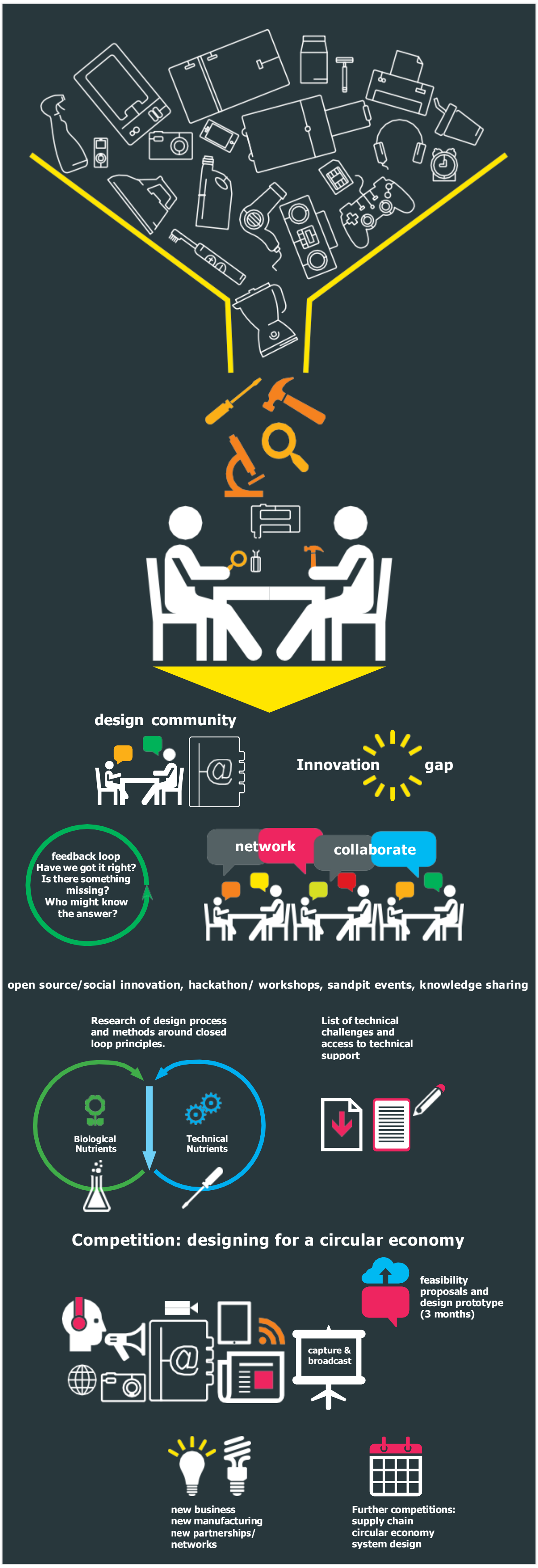
Addressing the UK design industry
Reaching our target audience as a whole is a challenge given the breadth of design disciplines and the lack of a single representative body, the different types of business practice (including those that might not recognise themselves as designers), and the programme's desire to target experienced design practitioners, as well as design students.

Our aim was to reach a mix of the design disciplines: from architecture to interiors, products to furniture, ceramics to textiles, graphics to digital, manufacturing to design engineers, systems to services, and many variations in between. Out of these groups we were particularly interested in attracting the large number of in-house industrial designers often described as the 'powerhouse' of the UK design industry. It was also important that we connected with those designers who did not consider sustainability to be part of their creative process.

We collaborated with a number of existing networks in the different design disciplines including the awards body D&AD, Royal College of Art alumni, RSA Student Design Awards past winners, Royal Designers for Industry, RSA Fellows and the design press to promote our activities.

The project launched in September 2012 with a networking event, competition launch and an exhibition stand at 100 percent Design, the UK's biggest design trade show at the London Design Festival. Working with curator Daniel Charny and our long-standing partners Bright Sparks, Islington Council's social enterprise repair and reuse shop, we re-created an electrical repair workshop in the heart of the trade show. The Bright Sparks team were on-hand fixing and advising for the duration of the event. Many people brought their broken kettles, hair dryers and toasters to see if they were fixable. Concurrently we curated a day of speakers on the public open day on the subject of the circular economy.

We had over 2,000 conversations with many people stopping to digest all the information on our exhibits. Most were keen to talk to us about the project's aims and where they fitted into our Circular Network diagram, which was on display. This early engagement also highlighted a particular problem around the writing of the design brief and the subsequent inability of designers to have the power to challenge it. It therefore became a priority to invite those who write design briefs to our events.



We have run seven public workshops, four organisation workshops, two networking evenings and four brokering events across the UK, attended in total by over 500 people.

Our website has a mailing list with 3,610 subscribers and we have 1,300 followers on Twitter. Our YouTube channel hosts the 18 films we have so far produced which have been watched 11,000 times. Our blogs and articles have been read by more than 9,000 people around the globe.

Over the first phase of the programme The Great Recovery has met and mapped out key stakeholders in the Circular Network. Here are just some of the people we talked to from the network:

The Brand/ Company

Matthew Polaine, BT's Senior Researcher on The Circular Economy.

We've realised (at BT) that our supply chains are key. They are key because when something's being manufactured at the front end of the supply chain, we need to tell them that it needs to be manufactured in a way that could help throughout its life cycle. If they have no vested interest in doing this, where's the incentive? We created the Better Future Supplier Forum, a campaign that BT uses to push the principles of circular economy into supply chains.

Where there could be a big advantage is economic clout. With a large manufacturer in the Far East, BT might represent two percent of their business. If within the UK we've joined forces with four or five other companies that are purchasing similar components from that company and we represent 20 percent of their business, then suddenly we have much more leverage in getting them to see our way of thinking. That's quite a good opportunity, but we're not at that level yet. There are still a lot of other things to be covered before we can get to that level of collaboration.

> Restart Project
> iFixit
> Fixperts
> Royal Designers for Industry
> Ticketyboo
> Useful Simple Projects
> Seymour Powell
> Thomas.Matthews
> Expedition Engineering
> ARUP
> Agency of Design
> Autodesk
> V&A
> Science Museum
> Design Museum
> Design Council
> 100% Design
> EcoDesign Centre, Wales
> MAKLAB

> London College of Communication, University of the Arts, London
> Royal College of Art
> UCL
> The University of Warwick
> Kingston University
> The University of Nottingham
> University of Bradford
> TU Delft
> Sheffield Hallam University
> Nottingham Trent University
> University of Cambridge
> Opening Minds Academies

> Technology Strategy Board
> PWC

> LCRN
> Lewisham Council
> Camden Council
> BSI
> BIS
> Defra
> WRAP
> Houses of Parliament
> Policy Connect
> European Government
> Science and Innovation Office Benelux
> UK Science and Innovation Network
> Resource Efficiency SIG
> British Embassy, Berlin
> EPOW
> Green Alliance
> Institute for Sustainability
> Ellen MacArthur Foundation
> BioRegional
> NNFCC
> Aldersgate Group
> Circular Economy Task Force
> The Resource Revolution
> Forum for the Future
> Friends of the Earth
> Gaia Foundation
> Tipping Point
> The Guardian
> Design Week
> Creative Review
> Computer Arts
> MADE magazine
> EDIE

> 2Degrees
> LAWR
> AJ sustainability

> SWEEEP Kuusakoski
> S2S
> Closed Loop
> WEEE Ireland
> NIPAK ltd
> LMB Textiles
> British Metals Recycling Association
> LCRN
> The Salvation Army
> ESA
> Veolia
> Van Gansewinkel
> Viridor
> Biffa
> Cat ReMan
> Bright Sparks
> Recycling Lives
> CIWM
> Ecolateral
> NISP
> Zero Waste Scotland

> What's in My Stuff
> Institute of Making
> Institute of Materials
> Ferroday
> NPL
> BRE
> Royal Society of Chemistry
> Granta

> Desso
> Cisco
> Interface

> Kimberly Clark - Europe
> Axion Polymers
> Saint Gobain
> Dupont
> EEF
> The Packaging Society
> Plastics Europe UK
> BASF
> Asda
> M&S
> Lego
> Google
> Philips
> P&G

> BT
> O2
> Fairphone
> Kyocera
> Unilever
> Samsung
> B&Q
> Asda
> Sainsbury's
> Travis Perkins

> McCann Erikson
> UCL Anthropology
> Which?
> Collaborative Lab

Workshops

Every time you get pulled back to the reality of things, and get your hands dirty, there's always a benefit. It brings you back down to earth to actually solve things at the coal face, rather than floating away in the clouds thinking 'wouldn't this be great'.

Sam Lanyon
Designer/engineer, Concept Shed

The programme for the workshops began in October and was phased to support the TSB competition 'New Designs for a Circular Economy'. In total, there were seven public workshops held around England, four dedicated workshops for organisations and a series of networking and brokering events, round table discussions and public debates at the RSA.

Our ambition was to get many different people representing all groups of the Circular Network together to observe, debate, tear apart, re-build and co-create a wide variety of products. Setting this multidisciplinary group the task of getting their hands dirty was the launch pad for exploring what it would take to develop a circular economy.

The workshops were spread out geographically around the country, to attract as broad a range of participants as possible. Each one was situated in an industrial facility that dealt with a specific type of material recovery or process. This located the workshop programme within the context of material resources and provided a visceral experience for participants. Seeing first hand the complexities and risks of not only sourcing, but also recovering materials, opened people's eyes to the challenges laid out in the introduction to this report.

In all the workshops the average mix of participants was 55 percent design to 45 percent 'other' from the Circular Network.

Disassembling a power drill

It's three o'clock in the afternoon in a fluorescent-lit room on a grey industrial estate in deepest Kent. The space is vibrating with the noise of destruction as 30 people intently hammer away at various gadgets trying to break them apart. This industrious mayhem is what is known as a teardown session. Expletives can be heard echoing around the room as the workshop attendees try, and try again, to crack into electronic appliances to retrieve the valuable materials trapped inside.

Amongst the melee, Royal Designers for Industry (RDIs) Terence Woodgate and Kenneth Grange are hunched over what remains of a power drill. Neatly laid out beside them are all the cogs, springs and other components they have successfully reclaimed from the tool so far. However, the motor of the power drill is proving impenetrable and it's driving them nuts. Terence is jamming a screwdriver vigorously into the object, trying to prise open the motor housing while Kenneth looks on with words of encouragement.

The setting of this Great Recovery scene is the recycling facility SWEEEP Kuusakoski (Specialist Waste Electrical and Electronic Equipment Processor) in Sittingbourne, Kent. This plant reprocesses 1,400 tonnes of electrical waste every month. A lot of it is broken down by massive industrial rock crushers once used in the Irish mining industry. The effort and frustration felt by Woodgate and Grange in trying to disassemble a power drill by hand is noticeable by comparison.

Workshop locations

Geevor Tin Mine, Cornwall

The participants ranged from practicing designers in service, product and engineering as well as HE design tutors and students. Following a tour around the now closed tin mine the group heard from The Great Recovery workshop facilitator, Mark Shayler on the element journey taken by the ingredients of a laptop, focusing on Tin and Indium, two elements that the mine would have produced. The group were then given electrical appliances including a washing machine, flat screen monitor, mobile phones and digital cameras. Tasks were set to rate these objects on ease of disassembly, value of components after disassembly, and rarity of materials. Discussions then focused on how we could completely redesign these products under a number of criteria, including design for longevity, design for remanufacture, design for disassembly and design for leasing. This process was mirrored in all the subsequent workshops.

Closed Loop, Dagenham

This event followed a very similar format to the Geevor event with a tour of the HDPE and PET recycling plant. The tour gave a glimpse into the innovative world of plastic recycling, including both the successes and problems that arise when returning packaging back to food grade. The group took apart multi-material packaging and products and discussed the challenges of redesigning for material recovery.

SWEEEP Kuusakoski, Kent

This workshop focused on e-waste disassembly and included a demonstration of SWEEEP's new furnace in action splitting the lead and glass from CRT television screens. The group took apart a number of electrical appliances including electric toothbrushes, radios, toasters, coffee machines and laptops.

S2S, Rotherham

This workshop was hosted by S2S, who work in recovery and recycling of electronics, including WEEE services through to decommissioning of IT equipment, refurbishment, re-sale, end of life recycling and secure data destruction. The tour demonstrated manual disassembly of electronics for re-use and refurbishment of electronics for re-sale. The group explored design for re-use in manufacturing and service design opportunities.

Cat Reman, Shrewsbury

A large group went out to Caterpillar's re-manufacturing plant, Cat Reman. Here the group investigated designing for disassembly and re-manufacture. The tour saw the manual process of taking apart and reconstructing engines, and discussed the business models and services needed around re-manufacture. The group disassembled engine parts and Cat Reman's electrical components and compared those designed for disassembly to others that were not.

LMB textiles, Stratford

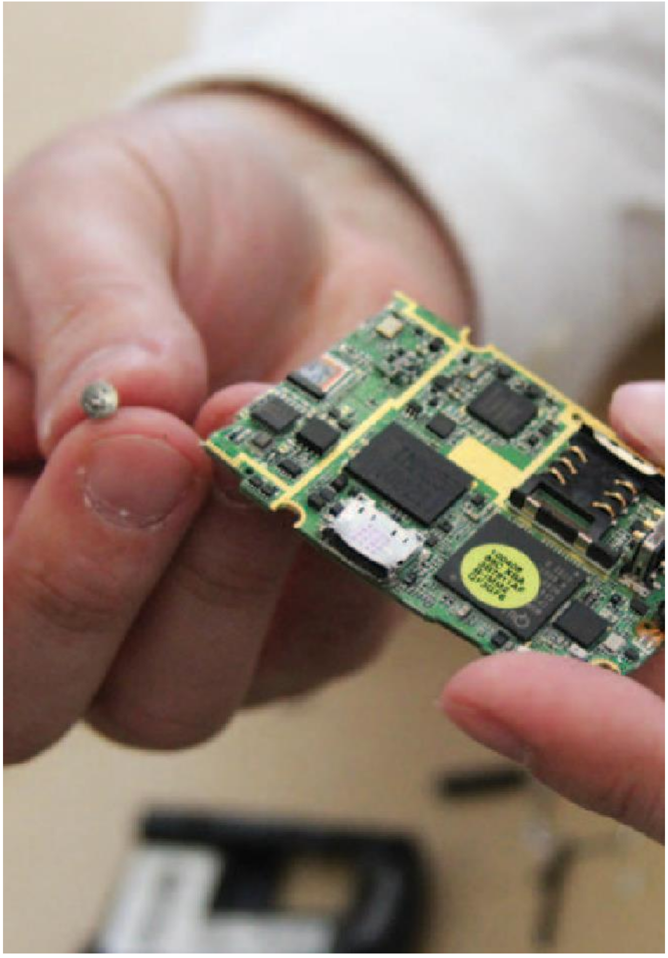
The host for this workshop was the family run business LMB textiles who recycle clothes from across the South East, sending most of them to Africa and Eastern Europe, where there is a huge market for second hand western clothing. The group learned about successful sorting processes, design issues around the consideration of re-sale and challenges around collection and quality control. Clothes and textile items were taken from the sorting bins and dismantled by the group.

MERI, Sheffield Hallam University

The Materials and Engineering Research Institute in Sheffield Hallam hosted a day where attendees worked with the laboratory staff and their hi-tech equipment to look further into the material composition of products at a microscopic level. Participants did a teardown on a number of electrical items, particularly mobile phones that were analysed for their element ingredients.
The group discussed challenges around re-sale versus material recovery in the electrical appliances sector.

Association workshops

A number of workshop were run for heads of sustainability, marketing and product development for manufacturing companies and corporate brands. Participants were asked to bring one of their own products for disassembly. They were asked to compare products that had been designed to be taken apart and those that hadn't. There were discussions on different business models for circularity and the barriers that hinder progress in closed loop design.



> In some of the large Japanese electronics factories a new designer will cut their teeth spending the first months on a disassembly floor where products are taken apart for recycling. Here they understand what components go where, what job they do and what the value is of each part. They also see where opportunities lie for improvement and efficiency.
>
> Sophie Thomas
> Co-director of Design, RSA

The workshop day

The workshops were designed to re-connect participants with raw materials. The day started with a tour of the industrial facility to learn about what it did and how it operates. Each of the sites chosen allowed the groups to connect with different challenges around resource resilience and circularity.

The groups then embarked on teardown and design-up sessions. Attendees were asked to guess the ingredients list in the products in front of them. Generally they could name around half. Most would write down plastic (carbon, oxygen, nitrogen and maybe chlorine) but not the antimony in the drinks bottle or fleece, (used in the manufacture of the PET), or the bromine in the polybrominated biphenyls that is added as a flame retardant to electrical casings made from ABS plastic. They were given a set of cards to help the process, each card representing an element from the periodic table and with additional information on supply risk.

Participants then went through the process of deconstructing an object (also known as 'teardown') in order to understand how it has been put together and how it can be improved. This is a well-established design tool. Many designers talk about their misspent youth tearing apart anything they could lay their hands on, with nostalgia and joy. It engages the practical maker/creative part of the brain and even the most cynical consultants and heads of finance attending the workshops had glints in their eyes when handed a pair of safety specs and a hammer.

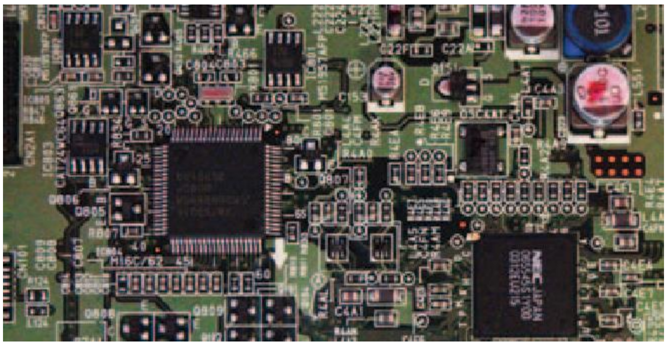
There were generally two types of routes to disassembly taken by participants at the teardown sessions. Some would take time to consider the object and attempt to take it apart screw by screw so that maybe re-assembly or even recovery of components could be achieved. Others immediately tore into the products, generally ending up with a pile of smashed up pieces. Both these routes of teardown had been witnessed on the tours and crudely represent the way industry recovers resource. The former was seen at S2S where they disassemble by hand and recover value in components for re-sale and the latter 'crush' process was seen at SWEEEP Kuusakoski where volume is the driver.

The experience of sitting in a materials recovery facility with a spudger and hammer in one's hands and a chunk of broken electronic waste on the table, that a moment ago was part of an enormous pile outside, is a very creative proposition for exploration. This is the premise on which The Great Recovery workshops were built. The workshops created a space for new perspectives and 'What if?' moments. Those that came to the workshops walked away from this process with a new sense of reality that came to be known as the three steps of 'Fear, Farce and Challenge'.

> The Fear is a reaction many of the designers have expressed when they are asked to look at the product they spent months designing, launched to much fanfare a year ago that now sits in the mountain of rubbish in front of them at the recovery centre.

> The Farce is the growing realisation that in order to make these devices, enormous amounts of raw material have to be sourced, numerous production processes are engaged around the world, and the products are transported from continent to continent incurring many ship and air miles.

> The Challenge is then to re-think the design of products from first principles. Pull an item off the waste mountain and take it apart. Understand what is in the product, where the materials come from and what job they are doing.

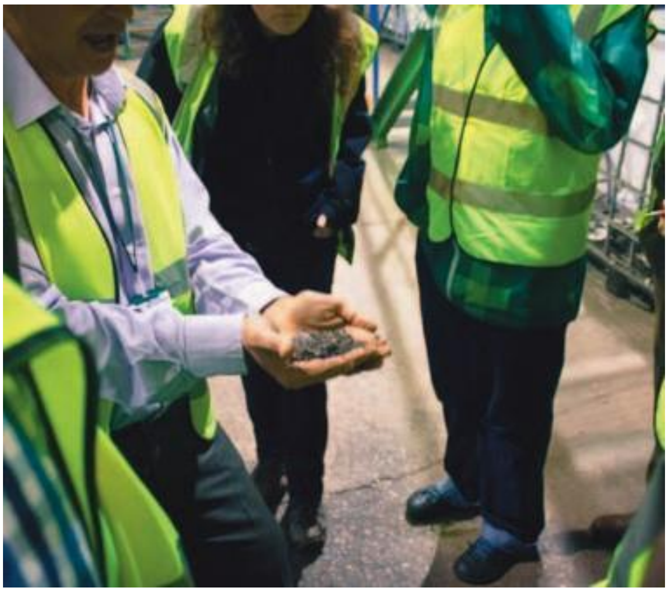


Is material recovery modern day mining?

At the SWEEEP Kuusakoski workshop in Kent, the workshop attendees begin to see how a facility like this, with its impressive 97 percent recovery rate of materials, is in fact a kind of modern day mine. It is an industrial site that extracts raw materials from waste. Some of the materials they end up with can be made into new materials.

The glass from old television screens melted down by SWEEEP Kuusakoski's specially designed CRT (cathode ray tube) furnace, is one great example (pictured above). The furnace is the currently the only one in the world and it can extract lead from up to 10 tonnes of funnel glass per day, that's the glass from approximately 60 tonnes of televisions.

This is one seriously profitable piece of kit. Apparently 1kg of lead can be extracted from each screen and, with its increasing value, the London Metal Exchange currently values lead at about £1,300 a tonne. At some point, when there are no CRT screens left to recycle, this specialist technology will become defunct. But, with approximately 1.9bn still in use globally, there is a guaranteed waste and revenue stream for several years to come.



The by-product of this extraction process is a grey glass that still has traces of lead (less than 1 percent). A design solution has yet to be found for it and SWEEEP Kuusakoski have so far developed an alternative to garden stones aptly named 'FAT' (short for Formerly A Television). But the results are somewhat lacklustre. This is a good example of the need for networked co-creation. If SWEEEP Kuusakoski brought good designers and craftsmen on board, they could see real value-added potential in their grey glass and designers would understand more about newly recovered materials they could specify in their work.

Observations from the workshops

'No-one has designed this system'

The result of doing a practical exercise like a teardown allows people to see things in a different way. Some things suddenly become ridiculous: A disposable electrical toothbrush becomes an electrical appliance with a four-month life designed with multi-moulded unrecyclable plastic, a long life battery and almost as many elements as a mobile phone. And some things become expensive: All LCD flat screen TVs have thin CLF light tubes with mercury vapour inside, which must be taken out by hand before they can be put through the crusher. Some models have over 250 screws requiring 15 different screwdrivers before you can extract anything. Every time a TV like this comes into a recovery facility the disassembler has to slow down to consider what tools they may need, reducing efficiency.

'Policy has a key role to play in design'

The workshops have been an excellent opportunity to start connecting designers and manufacturers. However, as the Circular Network shows, there are other key players who have a role in creating the circular economy. In the teardown workshop at SWEEEP Kuusakoski, as the destruction continued, Andrew Raingold, the director of the policy think tank The Aldersgate Group explained why it is important to have policy makers involved in The Great Recovery.

"The policy world is such a driver, in terms of the value certain metals have, in terms of recycling, and in terms of redesign. It provides the framework for plants like SWEEEP Kuusakoski, that have been driven by the WEEE directive." So why did Andrew come to this Great Recovery workshop? "I am interested in how we accelerate the transition to the circular economy. How do we keep the value of all these high-risk metals in the UK economy and the benefits that will have in terms of jobs and export potential."

'I didn't know so many were involved'

As well as building an informed and networked UK design community to drive forward the circular economy The Great Recovery sees need for the opening of industry supply chains in order to enable collaborative design learning. The way to start redesigning for better results in a resource scarce future is by re-examining the current system from the inside out. This involves getting to know what happens all along the supply chain. In the design and manufacturing world there are many segregated roles that are surprisingly not properly networked together. The client who sets the brief, the designer who selects the materials and creates the aesthetics, the policy makers that dictate the value of the materials, and the manufacturers who make designs a reality. Now, more recently, added to this line up is the end of life materials recovery role taken up by new entrepreneurial facilities like the ones that hosted the workshops.

'End of life is never in the brief'

Designers have a tendency to focus their effort on the manifestations of their creativity, which in the majority of cases is a physical product. But imagine if the brief was expanded out to become about the entire life cycle of materials which form the product for a brief moment, but are then designed to be taken back to their separate material streams. This kind of shift in emphasis would move the attention away from aesthetics and towards maximising the energy embedded in production, making sure that full material recovery was a certainty.

'This is designed for effective manufacturing, not effective recovery'

Designing with consideration to material flow would make co-moulded products, like the humble non-electric toothbrush, mentioned earlier for its 1.5kg ecological rucksack, first in line for a redesign. These types of products have manufacturing processes that mould two or more plastics together in one manufacturing step. This is very efficient and economical for the making but renders recovery of materials pretty much impossible.

These kinds of products make interesting design case studies and often came up in the workshops. They are designed to be cheap, disposable objects for specific tasks, in this case - plaque removal. Their design innovation lies in the ergonomic handle and, in the case of the toothbrush, in new manufacturing processes that can co-mould several plastics in one action: machine-constructed and impossible to separate. Like with a lot of these small inconsequential objects that clutter our lives the impact only rears its ugly head when you add up the mass: the USA sends approximately 25,000 tonnes of toothbrushes to landfill every year.

The toothbrush is a case in point where the raw materials are relatively cheap as long as the cost of the those materials (oil) stays low. Other products highlight the absurdity where a high quality specification meets limited life span. 'All-in-one' computers with their incredibly high-spec components are now pretty much impossible to repair or upgrade with a fused glass front panel onto an LCD screen. When the online repair site, iFixit took apart the new iMac they not only had to use a heat gun to remove the adhesive, but also guitar picks to pry the fused glass and LCD screen apart – a process only the strong hearted and confident consumer would consider undertaking. They gave the new model a measly 3 out of 10 on their Repairability Score scale demonstrating that the trade-off for this new elegant design is that it has effectively been designed for limited-use life.[15]

'I was surprised what was in it'

This ingredients list hidden within our products is another part of the problem – if you don't know what is in there how can you design a system to get it back out? It brings up a number of issues. Firstly, how far into the ingredients list should designers know and go? Design methods like Cradle-to-Cradle require extensive understanding of what is in products. Designers generally don't have this level of understanding and need to befriend chemists to get this deep. Secondly, these elements are often used in such tiny amounts that it is almost impossible and economically unviable to consider recovery unless these objects are brought together to create the volume. It is easy to dismiss the microscopic amounts of neodymium used in the tiny vibrating motor of a disposable electric toothbrush but worth considering when you add up the large percentage of small electronic appliances like the toothbrush or glowing party balloons lit by LEDs or a children's toy in a Happy Meal that disperse these vital elements across the waste landscape. This scrutiny of material make-up also helps the understanding of any potential toxicity and contamination that could occur in the later stages of material recovery.

'I've never talked to a waste manager before'

A networked supply and recovery chain is the key to enabling circularity. The Great Recovery's work has shown the importance of the design element being part of this discussion. Through the initial programme of workshops, events, networking and debates new connections were already developing across disciplines and across networks. This opportunity generated conversations between people who would never normally have interacted with each other in their usual job roles and fuelled new ideas and problem solving.

One of the most effective impacts was the immersive nature of the workshops. The participants swapped their studios and offices for rooms that overlooked enormous waste mountains deep inside packaging recycling plants, textile sorting centres and electronic waste recovery facilities. These places were physical demonstrations of the potential value in resource and the current best, but far from complete, practice of recovery.

The UK leads the world in many design and manufacturing skills. However, the threat of that knowledge being lost is all too real, because industry is failing to skill up future leaders as the experts move towards retirement. In the textile industry, for example, it is considered that in only five short years a whole generation of craftspeople and technicians will retire, taking vast amounts of knowledge with them that have not been passed down, the consequence of a declining manufacturing industry.[16]

'We weren't taught this at college'

The Great Recovery sparked many discussions around the role of higher education and continued professional practice (CPD) in design. While creative subjects such as art and design are currently being threatened by reforms in the school curriculum,[17] the UK's creative design degrees are still considered among the best in the world. Design colleges across the UK attract students from around the globe to study in their cutting-edge programmes. Yet the question of designing for resource efficiency has for years been regarded as an add-on, rather than set as the foundation of design education.

We are slowly seeing changes and more integration. Certain universities have sustainable design electives running inside their course programmes, or have parallel sustainable design degrees alongside the 'regular' courses. What is needed is a greater amount of cross-fertilisation between different disciplines. Just as the network of closed loop manufacturers, businesses, designers and material experts join up around the movement towards circularity, this model should be mirrored in education with cross-curricula collaboration and a more focused approach to system and service design, moving away from the product focus and closer to bigger systemic change.

'There are so many challenges, where do you start?'

The workshops were designed to allow people to find their own ways to deconstruct barriers. Whether that was by breaking apart a mobile phone with their bare hands or taking the time to understand the challenges faced by the workshop participant and member of the network sitting next to them.

The teardown's atmosphere of creative destruction was not only an educational experience for people, but also an emotional one. They found it both frustrating and satisfying. People liked using their hands and having to do something physical. It made a welcome change from their usual desk jobs. Conversation was aided by the physical interaction and by the end of the day, in the concluding session, people felt more comfortable sharing their opinions with each other due to this novel shared experience.

A final observation from the workshops is that everything is connected, from the way we design the packaging and market our consumer goods to how we deal with and recover the waste materials coming out of households and industry. The workshops clearly illustrated how easy it is to build in negative environmental impact at the design concept stage by designing in isolation. Working through the challenges with the right network around you avoids these pitfalls and creates great opportunity.

> It has been a joy to meet with designers from all sorts of backgrounds and realise the appetite they have for understanding the journey materials take through product lifecycles.
>
> Dr. Michael Pitts
> TSB Lead Specialist, Sustainability

The Brand/Company

Neil Harris,
Green Technology and
Innovation Manager at Cisco.

One of the things that really struck me about The Great Recovery workshop, as somebody doing what I'm doing, and maybe for others as well, is that you don't touch stuff anymore. We're all on our laptops or all in meetings. It's very rare that we get an opportunity to get hands-on and tactile with things. It's a good reminder of the complexity in electronics, in all types of different electronics; consumer, business and computing.

I've really enjoyed taking things apart and having a look at what's inside. I had some really good conversations with some folks on other tables about the value of the material that they're pulling out of these products, these little circuit boards. I just wonder, "How much is that worth?". There's gold on it and there's a few capacitors on it. It's probably only worth a couple of pence, but when you start to deal in tonnes of this stuff it becomes quite valuable.

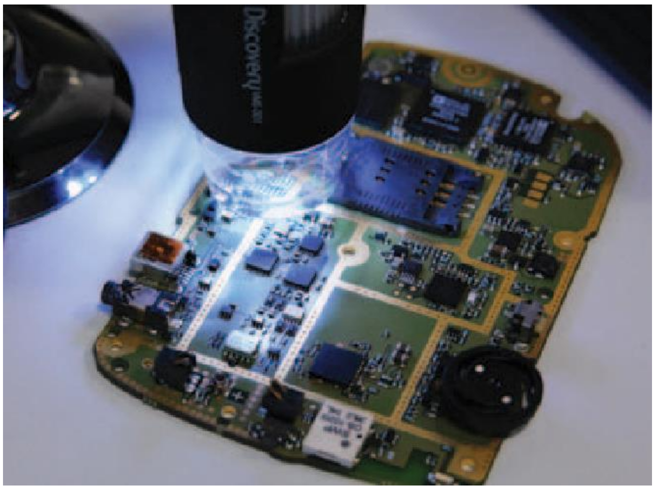
I've been told that a tonne of circuit boards is worth about 1,130 euros. That's a lot of money and will be of interest to lots of people. There is a much more upstream kind of conversation happening here, the designing, the engineering, the production, the sourcing aspects of business and business production – that's really good.

The Anthropologist

Adam Drazin,
UCL Anthropologist in Material Culture.

Twenty or thirty years ago, very few anthropologists were working on objects or materials as cultural in themselves. Now we are engaging more with design, because design is the way in which this interest in material culture can make a difference politically or socially. This engagement is in many ways a natural extension of what we have been saying for years – that the material world is important for political participation, for critique, for identity, for relationships, for practices. You can't continue to assert these kinds of things in the abstract, you have to engage with design at some point and design has to engage with anthropology.

What's very important to me is that this is not only about good design work but good social science. Sometimes in the past, the connection has been a one-way street, where an anthropologist does some ethnography 'for' design. Increasingly, iterative design methods are coming into anthropology, and they are good for some kinds of social understandings. Although you can't beat good old-fashioned modes of long-term participant observation in anthropology, you learn more when you begin to incorporate methods such as sketching, prototyping or iterative co-design.



Open Workshops
1. Geevor Tin Mine, Cornwall
2. Closed Loop, Dagenham
3. SWEEEP Kuusakoski, Kent
4. S2S, Rotherham
5. Cat Reman, Shrewsbury
6. Sheffield Hallam University
7. LMB Textiles, East London

Brokering Events (with the ESktn)
1. Engineers House, Bristol
2. The Midland Hotel, Manchester
3. Crown Packaging, Wantage
4. Recycling lives, Preston

Association Workshops
> Opening Minds, RSA
> The Aldersgate Group, RSA
> The EEF, London
> Green Alliance Seminar, London

Networking at the RSA
> Great Recovery Launch
> The Great Recovery Phase 2 Launch
> Redesigning the Future panel debate

The Consumer/User

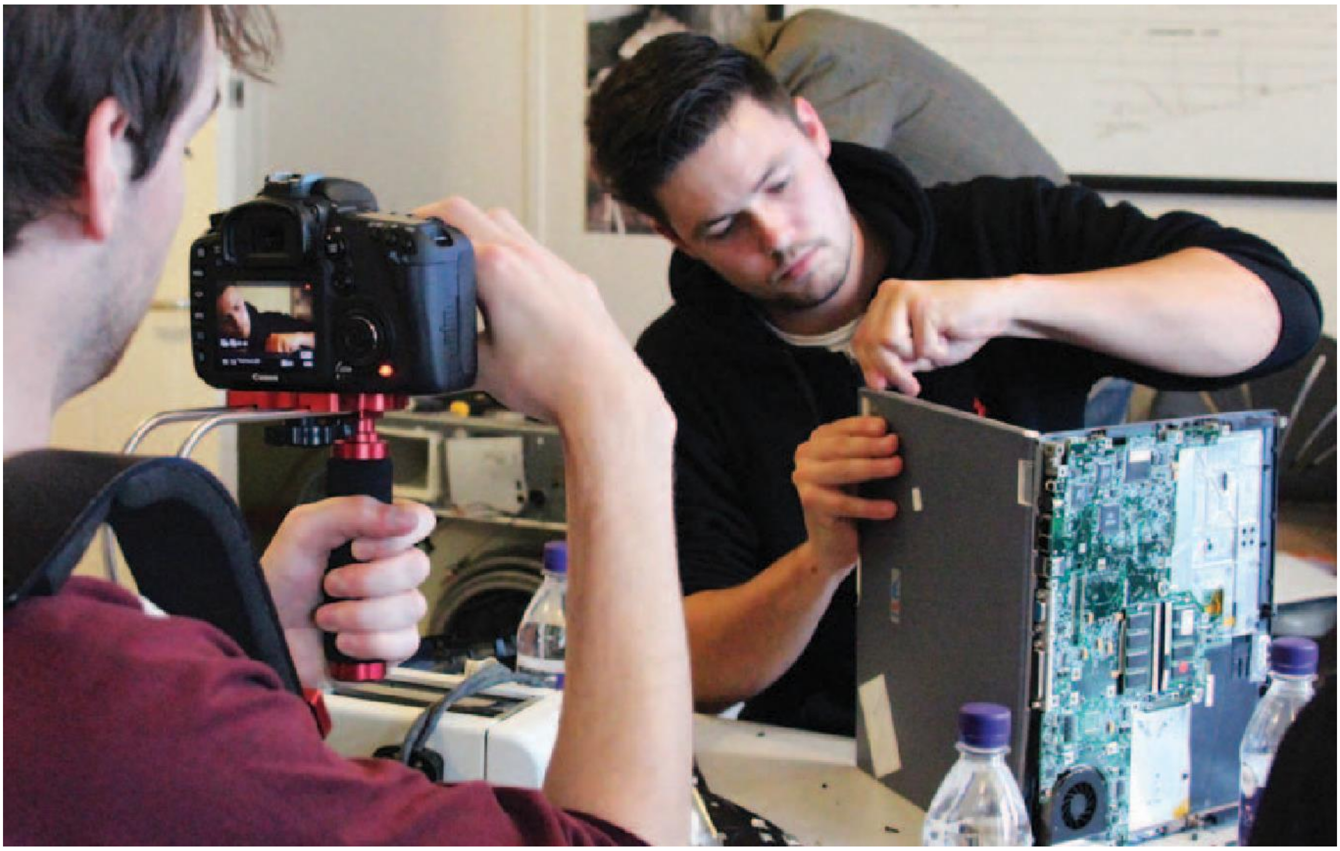
Andrew Foxall at the LMB Textiles workshop. Director of Foxall Studio, fashion brand consultancy.

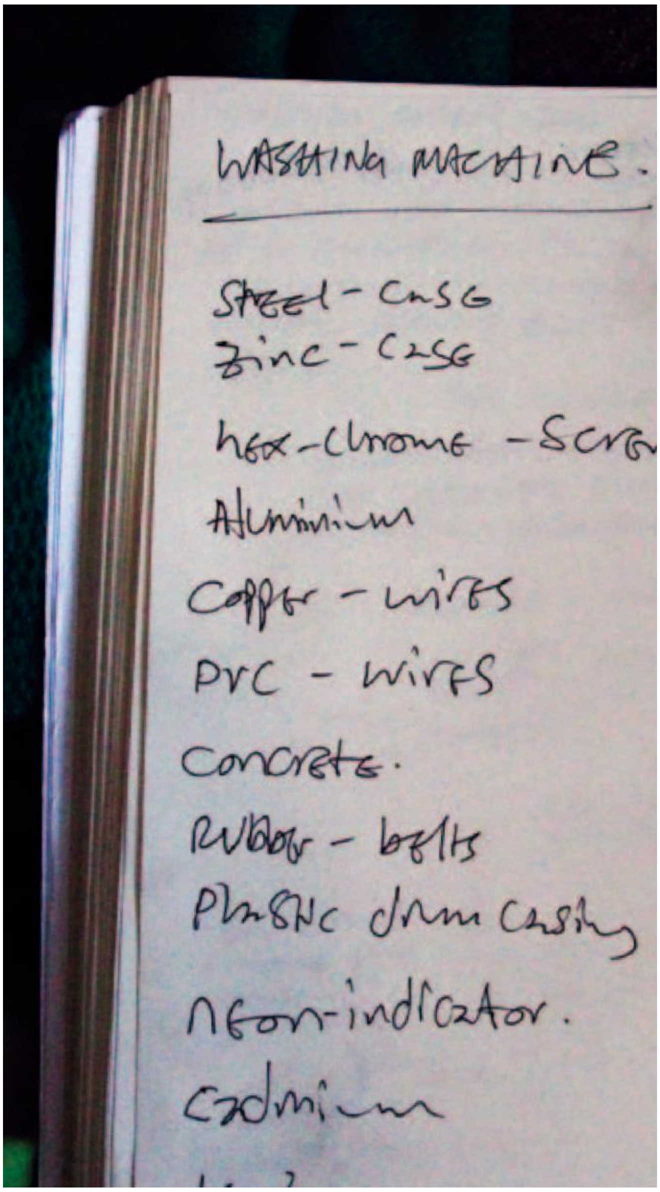
Sustainability has been a big buzzword in the fashion industry over the last couple of years, so any sustainable thinking is great for brands in high fashion right now.

We've been on a tirade about the front of the system, the consumer, where the products go in, and how corporations are having to completely change the way they sell and where their responsibility lies. The elephant in the room is the fact that it's a consumer problem.

Consumerism is the least sustainable thing we do, but what brand is going to want to slow down consumerism with the existing model to sell more and boost the economy?

You have industry magazines one week saying its all about sustainability and the next week it will be, "Government says let's open our shops later". It's a paradox. But here I started to hear a lot more about the design side. I had been so interested in the 'consumerism' issue that I had forgotten about the nuts and bolts of it all, literally the nuts and bolts, or the zippers and flies.





The Design Engineer

Sam Lanyon,
Director of Concept Shed.

My background is in electronic engineering and I'm interested in elegant solutions to things. A lot of these e-waste products aren't elegant solutions, so it's great to come to a room full of people that are looking at these products with a critical eye.

Generally consumers just consume, they don't stop and question. It's nice to pull things apart with people for whom it's really exciting and surprising. We can create some hope for this to become the norm. People should question and ask "What am I buying in this box?". They should look inside and say, "There's nothing in here, why am I paying this money for it?" or "This looks rubbish. It looks cheap and is badly made. I want something better, I want something that will last".

People are surprised when they take the lid off something. Like when they take the lid off the washing machine and ask "Why is it so heavy?". Because there's a load of concrete there as ballast for the drum.

Competition

One day, all this will simply be good design and we will no longer need to talk about it as an issue. If The Great Recovery can help us reach that point, by mobilising designers and all the other supply chain partners to the challenge, that would be a real win.

John Whittall
Technology Strategy Board

The Great Recovery has set out to demonstrate the urgency of developing a circular economy for a sustainable future, whilst strengthening the argument for inclusion of creative thinking in process redesign and the propagation of important technical expertise. The UK sits in a unique position of need and skills with its great heritage in making and manufacturing in the UK.

The aim of the programme's workshops has been to open eyes to the extraordinary new opportunities in designing for circularity. This in turn has encouraged those that have engaged with us to collaborate with others to submit high quality entries into the Technology Strategy Board's competition, "New Designs for a Circular Economy".

This open competition, aimed to stimulate innovation in design addresses two high-level challenges:

1. Reducing the global environmental impact of materials that we use.

2. Reducing dependence on key raw materials, the supply of which is potentially at risk.

The designer's oxygen is creative instinct rather than metrics. Yet those designers working on resource efficiency for big brands are being asked to tiptoe around the core product with a calculator. Here the carbon metric is king and reducing product weight by thinning a bottle or substituting a heavier material that may already have an established recycling infrastructure for one which has none (an 'eco pouch' being a case in point) is seen as a success.

These incremental changes are keeping people very busy whilst avoiding bigger, more complex issues. In contrast the TSB competition invites designers to use their full potential in redesigning not just single products, but, more ambitiously, whole systems and services. To quote Mark Shayler, "It's not about doing things better, we need to do better things".

The selected winners for the two rounds of the competition, in December 2012 and March 2013, were awarded up to £25,000 towards feasibility studies which tested new ideas and investigated new products and services that closed the loop.

Further competitions are planned in the subject area of resource efficiency, closed loop and supply chains with a strong emphasis on design collaborations.

TSB Designs for a Circular Economy – Competition Winners	
Alsitek Ltd	Substitution for non-recyclable fireproof foam and lightweighting for dematerialisation
Alterix Ltd	Large scale interactive multi-touch displays
Applied Nanodetectors Ltd	A new design for a handheld reusable non-invasive breath test for blood glucose monitoring and diabetes self-management
Autocraft Drivetrain Solutions Ltd	Electric Vehicle Battery Remanufacturing (EV BATT-RE)
Axion Recycling Ltd.	Outdoor media banners – Design for recycling
Bond Retail Services Limited	Feasibility Studies to implement the Circular Economy model in large retail food cabinets
Bottle Alley Glass	Glass bottles into construction materials
Clarity Sustainability	Reducing the Environmental Impact of Branded Event Communications
Dyson Ltd	Assessing the through life impact and understanding the implementation steps to using bio-polymers for Dyson products
Ecobond (Cymru) Ltd	The RE-Fab House – Enabling Re-Useable Construction
Ecocap Limited	Ecocap Ltd
Haydale Ltd.	Nano Particle Polymer Enhancement for Recycling Sustainability (PPERS)
Hugh Frost Designs Ltd	Freight*Lift palletless material handling system
Imperial Chemical Industries Limited	Project Recover: new life from old paint
KeepCup Ltd	Reusable Hashi made from Disposable Hashi Waste and Biopolymer
Kingfisher Plc	Return to Sender
Kingfisher Plc	Circular Design for an Economy Power Tool
Kingfisher Plc	ProjectBox
NewCatCo	Circular Design and Processing of Green Sustainable Products of Material Benefit
Phineas Products Ltd	Feasibility of Implementing a Circular Economic Business Model for Phineas Products
Powervault Ltd	A New Lease of Life for Expired Electric Car Batteries
Raw Studio Ltd	Modular Bicycle Frames
Re-Considered Ltd	Development of an innovative, reclaimed textile fibre furniture range
Re-worked Limited	Coffee Board: Designing an energy-light closed loop system for waste coffee and plastics
Rich Coles Packaging Associates Limited	Design of re-usable biomaterial packaging systems for the chilled meat and fish industry
Soltropy Limited	Investigation of the use of silicone sponge tube and design study of other components in solar thermal collector
Systematique Ltd	Closed-loop manufacture using recycled UK Polymer (CUP) – Systematique
The Agency of Design Ltd.	Closed Loop LED Bulb
The Agency of Design Ltd.	Connected closed loop kettle
Treebox Ltd	Servicing Greener Cities
Toyota (GB) PLC	Design requirements in product, process, organisation for End-of-Life Vehicle (ELV) to achieve Circular Economy State
Useful Simple Projects	Polarising designs: Redesigning neodymium magnets (NDM) for the circular economy
Useful Simple Projects	Design of new tools for closed loop manufacturing
We All Design	Project Recover and unBuild: Beyond WEEE regulation
4G Design	Sustainable Retail Design: A Closed Loop Life Cycle Assessment strategy

More ambitious design goals

One of the competition winners, Rich Gilbert, co-founder of The Agency of Design, made the case for more systemic design at the RSA Redesigning the Future panel discussion in April 2013. Recounting the design journey he went on to develop a proposal for the TSB competition, he expressed his dismay on visiting material recovery centres such as those that hosted The Great Recovery workshops.

The amount of time, effort and detail that product designers like Gilbert spend putting into their work is roundly mocked at the end of the device’s lifecycle when it is destroyed by an all purpose crushing machine. “Should we,” as Gilbert asks, “really design something to get shredded better? That doesn’t seem like a very ambitious design goal.”

Gilbert continues with this advice for fellow designers. “Make sure you redesign the right thing. A lot of human exertion goes into carefully designing and assembling products, but the disassembly is so crude – just smashing them up. The design challenge is more systematic.”

The Resource Manager

Nick Cliffe,
Marketing Manager
at Closed Loop Recycling.

If we did more efficient presorting of plastic bottles then it would make a lot of machines we use at Closed Loop redundant. In Austria a 500 kilo bale will have 98 percent PET content. Their contamination levels are much lower. If you tell a German to put a PET bottle into a PET bin they tend to do it. But here in the UK co-mingled collection means we have so much pollution in our plastic bundles.

Some local authorities are stepping back from co-mingled collections. Let’s look at this seriously. 25 years ago everything went straight into landfill. The waste industry had a very simple flow diagram – there was one arrow from the house to the dump. Now there are all sorts of routes to the recycling facility.

It’s taken local authorities a long time to understand that they in effect are becoming more like oil companies, mining companies and forestry companies as we move towards the circular economy. They are the primary producers of recyclables.

As they gain a better understanding of the value of these materials, it informs their decision making. They have been very quick to outsource the problem to waste companies. Waste companies understand the value of recycled materials. The local authority charge the waste company per household – 75,000 houses in one local authority, £5.18 per house – that’s the bill.

But the more switched on authorities say if I spend more time and money improving plastic recycling rate from 25 to 60 percent you are getting more value from your materials and a reduction in collection costs. You don’t need many local authorities to come together to see them controlling enough plastic to build one of these Closed Loop facilities. It becomes all about value not volume.

3

Outcomes and Recommendations

Outcomes

“

Today we saw that every solution poses another problem. A great example was someone, with the best intentions, designed an ecological bamboo case for a computer that actually messes up the recycling process. I would never have thought of that. It’s only when you come to workshops like this that you can then make informed choices about design”.

Terence Woodgate,
Furniture and lighting designer,
Royal Designer for Industry

To date, the discourse around the possibilities of designing for closed loop manufacturing has been optimistic if, perhaps, overly simplistic. The myth that our single planet can provide the human race with unlimited natural resources has been dismissed and the business opportunity through closing the loop has been set out.

It is widely agreed that many of the materials that feed our production are increasing in scarcity. We may soon be reaching points of peak everything: oil, gas, coal, water, metal, and minerals. The race for resources is also playing a pivotal role in ongoing geo-political conflicts around the world. With all this information, surely the way we design our products and services can no longer disregard the continuous stream of materials into the landfill.

There is logic to solving current problems through better design for resource efficiency. Intellectually, most people involved in these discussions have understood the imperatives driving the UK towards circularity. And to do this there are many routes designers can take towards circularity, steered by the brief given and influenced by the client, the material processor, the brand, and the consumer.

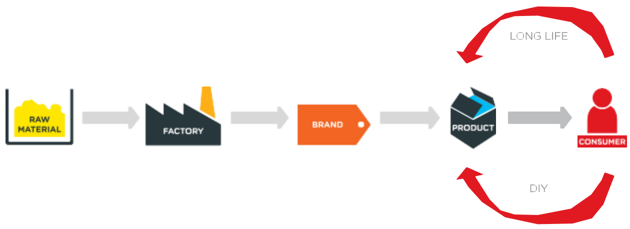
All require a system design re-think. In exploring the possibilities of designing for circularity and through the observations of the workshops, the Great Recovery has identified four main design strands that fit within the Circular Network.

Each has its own design considerations and challenges and its own network of collaborators who need to be involved in the design process. These four design models are set out overleaf.

The Four Design Models

1. Designing for Longevity:
This route is closest to the consumer/user and must therefore be designed to maximise the embedded material and energy from production stages. This is about designing products that last, are well crafted and well made so that people don't want or need to throw them away. Products on this loop should be designed to have a long life span, extended through user action of upgrade, fixing and repair. This kind of relationship requires readily accessible information and product service manuals. These products are designed to be taken apart easily without breaking any security seals or glued components. When they fall out of favour with the user they should be encouraged to pass them on. Products on this loop should be designed to be desirable in their continued workability and trusted as something that has a long and adaptable life span. They should also be designed with consideration as to how users attach themselves emotionally, highlighting a key role for anthropological insight.

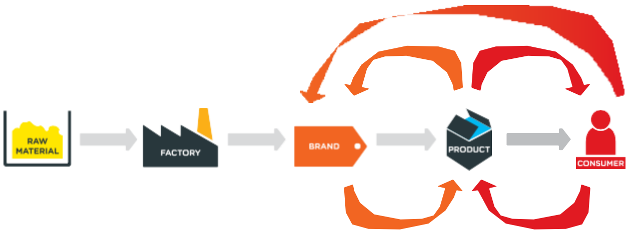
Design for longevity was pretty much wiped out by built-in obsolescence and access to cheap global production. However, the emergence of a new fixing revolution is questioning the consumer's attitude towards wanting the 'new and improved' before the 'old' has lost its shine. There are big barriers to overcome before longevity becomes a mainstream design option again. The biggest obstacle sits within the business model that creates profit from selling more units and where unit costs must be as low as they can, making material choice and quality suffer.



Obstacles like intellectual property laws and company secrecy around production methods hold up or complicate user fixability. Transparent supply chains and open-source operating manuals would open up huge opportunities for design.

2. Designing for leasing/service:
Digital platforms and changing consumer behaviours are allowing people to share and lease products as an alternative to owning or buying. Car sharing businesses are now a common and accepted practice, and this sharing model is rolling out to other products.

Service design is a growing area and is a key component to effective circular economics. It allows for higher specifications of design and materials that increase life and durability. The material stays in the ownership of the manufacturer as the product is never sold, so value is kept within the system.

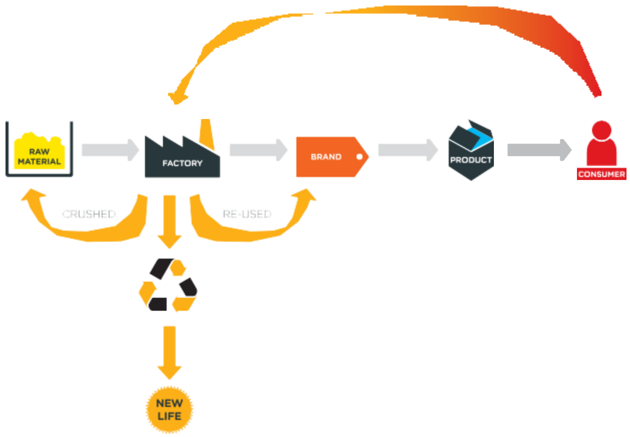


Sharing and leasing consumerism has its own design challenges, which mostly sit in the business model. If many people are sharing a product how do you design it differently? How can new warranties be redesigned to support these new industries? What incentives are put in place to make sure products, and more importantly their materials, get back into the system rather than being stuffed into drawers or lost in landfills? How can profit be created when there is no option of selling in the new and improved model in 12 months time? Currently services and repairs are not exempt from VAT. Making repair a tax-free service would bring immediate benefit and incentive to move to a leasing business model.

3. Designing for re-use in manufacture:
With current infrastructure that supports a 'crush and melt' method to waste management, pushing a 'design for disassembly' approach seems premature. The Great Recovery workshop highlighted the need for incentives for companies to invest in new toolings or factory jobs for deconstruction.

The re-capturing of material through new system designs that guarantee the return of the product into their material stream reduces a company's risk to increased price volatility. Increased Producer Responsibility (IPR) and new closed loop partnerships would push businesses to think further out from just their supply chains.

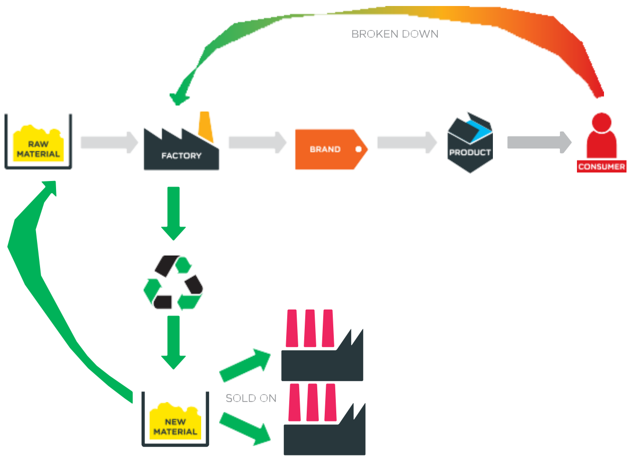
These types of business relationships known as 'industrial symbiosis' networks can offer opportunity



to design a closed loop system, where waste from one business is captured and used as raw material for another. Individual Producer Responsibility would help to switch the focus onto value of material rather than volume, and would incentivise investigation into designing products and services that brought old products back in to the manufacturing systems for service, fixing and upgrading. This is designing for longevity at a manufacturing scale.

Designers need to work more closely with the manufacturers to see where opportunity lies with smaller businesses. Government should address UK legislation where a product with a re-manufactured part cannot currently be sold as 'new' under the Trade Descriptions Act.

Designing for material recovery:
On the outer loop the fastest flowing products like packaging need to be fed into a recovery stream as soon as they have finished being used. This is the area where the UK is currently doing pretty well. Initiatives like the Courtauld Commitment on packaging coupled with increased resource costs have incentivised growth in the resource recovery businesses. Even so our lack of understanding in the design industry around effective material recoverability can create more waste through misinformation, which can contaminate valuable recovered materials.



Proper network dialogue between designer, resource manager and recoverer is key. Fast moving consumer goods (FMCGs) should be considered for redesign to match the capability of recovery facilities. This collaboration will bring innovation on both sides allowing for true material capture. The design brief must be strongly influenced by the end of life of the product. There should be restrictions, even phase-out of multi-material packaging that, because of the nature of the design directly impacts its effective recovery. Increased recycled material use should be normalised and accreditation bodies must help build the case for specifying more recycled materials by developing certification and metrics to level out material quality.

Material and Information flows
Sitting in parallel and with equal importance is the flow of information that makes the materials move from one process to another. At every point when material passes on, knowledge of what it is and where it goes next must be passed with it.

If the information falls away or is miscommunicated, material is lost or misplaced. An example of this can be seen in the conflicting recycling information from different local authorities which confuses and aggravates households, often leading to resignation and the default position of putting everything in the black bin.

With each of the four design routes within the circular economy, information flow plays a vital role: Within design for longevity, the user must have easy access to freely available information, in order to repair and upgrade so that their product has an extended life. Such objects may be passed to other users, so information must be passed on with them. When the product finally becomes irreparable the owner needs to know what to do with it.

For design for leasing, information builds up trust in the system. The user must know when and where to send the product back for upgrade or replacement, building up a long contractual relationship with the brand. A profitable lease model relies on additional services so trust and honest communication is key.

As with design for leasing, design for re-use in manufacture must have strong user/manufacturer information channels so that the used product goes directly back to the factory. This process could be encouraged through a deposit system or collection option, making return as hassle-free as possible. With design for full material recovery there should be no confusion that could result in contamination of the flows of material into the recovery facilities. Communication on what can and can't be recycled must be communicated clearly and there should be help at hand to make sure no valuable materials are lost.

Building systems that incorporate these flows get more challenging when considering longer-term products like houses. Some materials, for example steel, can stay in 'societal use' for long periods of time (compare a steel girder to a disposable coffee cup). At this point the design must build in a way where information can be carried over unspecified periods of time without becoming obsolete through technical advances, or unreadable through degradation, or gets detached from the material in question.

In all cases if the flow is working well there is little leakage. Fewer materials are lost and more opportunities are made with increased communication through the network.

Closed Loop Recovery facility

Within the factory process there are a myriad of hurdles to creating food safe recycled products. The Closed Loop facility system could be seen as a microcosm to the industrial system as a whole.

Plastic bottle recycling is constructed around consumer waste and the way it is collected. Closed Loop recycle PET and HDPE to food grade standard. These types of plastic are both widely collected through local authority collection systems. This is generally through either a 'co-mingled' method where all domestic recyclable materials are put together into one bag or a 'kerbside' system where the household sorts and the collectors separate into different compartments in the collection vehicle. Closed Loop have to navigate huge variation in quality and output from these schemes. They then have to negotiate what their clients see as consumer demand. For example, consumers don't want to buy their milk that is contained in a milk bottle that has a slight green tinge because they perceive it to be off. This tinge is an outcome of the recovery process, from the colour of the lids. The white HDPE is becoming tinged by our preference for semi-skimmed milk. We have confusion at the consumer level on whether to leave the green lids on or off. The recovery facilities are having to employ cutting edge technologies to counteract the inadequacies of an out of date service structures and this makes for an unstable system.

The next steps towards circularity

Through the workshops, The Great Recovery has collected a significant amount of commercial, industrial and creative insights into manufacturing, production and resource management. The principles of this learning can be applied across disciplines and industries in a knowledge transfer process, an ambition for the next stage of The Great Recovery project.

The 'design for circularity' diagram showing the four design models begins to break down the complexity of moving from a linear to a circular system. It gives designers and businesses a steer on how to think about their briefs and apply logic to the life cycle of each product, system or service they create.

The design models also categorise designers as problem solvers, providing four different frames in which to consider the best solution to their current creative challenge and points the way to the network collaborators who should be involved in their design process.

The Manufacturer

Ben Reed,
European Engineering and NPI Manager,
Caterpillar Remanufacturing.

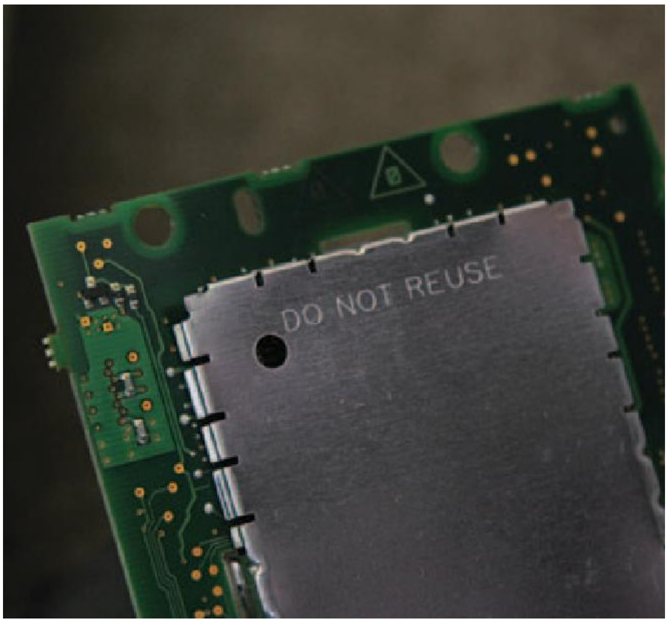
At Caterpillar we are always looking for ways to spread the message about remanufacturing, and the difference between a properly organised industrial scale process like ours and the smaller 'refurbishment' or 'reconditioning' type outfits.

Doing this process in a factory environment with proper quality controls results in a superior product which we back every bit as much as the equivalent new components with the same warranty and support. In addition to spreading our message, we also wanted to learn about other companies and get a feel for how we sit in the circular economy.

The best part of hosting The Great Recovery workshop was realising just how good an example of the circular economy our business is. I always knew what we were doing was the right thing for the environment, but when I look at the challenges other industries face it was clear that we are more advanced than most.

If anything, it has strengthened our resolve to continue pushing the boundaries of salvage engineering and remanufacturing. We are already proud of what we do, and we know we can go further.

As Jonathan Chapman said at the RSA Redesigning the Future panel discussion "Design has always been about change and reinvention".[18] The question this report seeks to answer is how to ensure that this change and reinvention is not just an end in itself. Design must be used for the pursual of the triple bottom line, not just the short-term benefits of profit today. Good design has historically been defined around creating beautiful forms with exceptional functionality. It seems timely to add that good design must now also be circular in its material flow.



> As we see smarter technology, faster technology, more connected technology, our dependency on materials grows and our dependency on more exotic materials grows as well.
>
> We're very interested in how we can maintain supply of those materials to enable our business to function, to enable us to provide our markets with great technology. Of course there's a business opportunity for us in being really good at, or building smart interpretations of, the circular economy inside our company."
>
> Neil Harris
> Green Technology and Innovation Manager, Cisco

This report concludes with our initial recommendations from The Great Recovery project and our proposed next steps.

1. Skilling up the design industry

A. Prepare future generations of designers. Embed circularity in the design education system. Sustainable design must not continue to be left behind or added as a last minute thought. Make sustainability a matriculation criterion in every design and engineering degree. Encourage multi-disciplinary learning based on an understanding of the lifecycle of the products and services.

B. Encourage creative approaches. New and existing tools need to be realigned around the challenge of designing for circularity. Established tools like the teardown process are highly effective but not commonplace in design thinking.

C. Designers must be bolder and broader. New generations of system thinkers are needed. Designers need to re-set their definition of beauty to encompass the whole circular life of the materials and processes within their product and design out waste.

D. Re-kindle skills which are in danger of dying out. Encourage investment in capturing dying craft and trade skills in manufacturing and investigate their adaptation for emerging technologies.

Actions:

Develop further and higher education modules to integrate design for circular economy and systems thinking into a wide range of design curricula.

Develop an education programme that encourages cross-curricular learning, connecting designers with engineers, material scientists, anthropologists, marketeers and business students.

2. New business approaches

A. Redesigning the brief. Businesses must begin to develop design briefs around new business models that take account of provenance, longevity, impact and end-of-life. They must consider a circular approach.

B. Foster new technological partnerships between the design, suppliers and waste industries. Short lifecycle products such as FMCGs should be redesigned to prioritise full material recovery. Packaging design briefs must match the capability of our recovery facilities and where innovation occurs, it must occur on both sides.

C. Build incentives to develop and design new industrial symbiotic relationships in business. These systems could potentially bring great opportunities in new markets and create local partnerships and jobs. Investigate networks and information flows to enable these links to develop.

D. Shift the opinion that design is an 'add-on'. Promote the Technology Strategy Board's competition requirements that partnered the skills of design and business to solve problems through the redesign of whole systems.

E. Investigate consumer behaviour and attitudes. Create new incentives around leasing and take back. Investigate growing models of consumption that work on collaborative sharing systems and develop new warranties and social trust systems that can be transferable to many products and services.

Actions:

Help businesses to develop briefs that incorporate resource efficiency and closed loop principles. Support the commissioning of effective design that incorporates circular economy principles.

Broker new dialogues between the designers, suppliers and the waste industries to instigate new collaborations for innovation around end-of-life, with an initial focus on packaging.

3. Networks: connecting and collaborating

A. Create access to new spaces that allow collaborative R&D for businesses and their supply chains to test, trial and design around circular principles and the four design models; design for longevity, design for leasing/ service, design for re-use in manufacture, and design for material recovery.

B. Investigate the common barriers to collaboration in circularity. Explore ways that can encourage frank business learning through the network. Explore the legal barriers and opportunities for closed loop collaboration.

C. From consumer to user. Build the debate around ownership and how we effect this in the approach to design, and build a movement to redefine the connection with the stuff we consume.

D. Open up supply chains to scrutiny. Question cheap global production through the advocation of transparent supply chains by supporting those that campaign and expose bad practice.

E. Move towards the designing out of built-in obsolescence in products through an investigation to the shift into business models developed around design for longevity.

Actions:

Create a physical space where industry stakeholders can come together to test product, systems and service design, supported by a network of expert consultants.

Develop design standards and tools to support closed loop design and continue to build the online library of open source information about closed loop design and the circular economy.

4. Pushing the policy

A. Multi-layered packaging which prevents or increases the complexity and cost of recycling should be designed out. At the same time, investment in innovation fully recoverable mono-material packaging should be supported to increase greater resource recovery.

B. Encourage the transparency of information. Too much knowledge is hidden and left to speculation. Open source service manuals will bring product transparency and allow designers to build in fixability, upgradability and longevity.

C. Redesign the systems. Transparency in process and supply chains will assist the redesign of systems, build consumer confidence and open up opportunity to make bigger resource efficiencies.

D. Laws and accreditation must be fit for circularity. Review the laws that hinder re-manufacturing with used components and that make repair an expensive option.

E. Investigate accreditation systems for recycled materials. Begin to comprehensively test recycled resource materials so that they have potential to attain grade quality levels that are equivalent to their virgin counterparts. This will build confidence for designers to specify and open up new markets for recovering and reprocessing.

Actions:

Open up dialogue with government around new legislation to encourage packaging design for full recoverability.

Encourage companies to provide full operating and repair manuals for all electronic products.

Enable discussions with the Circular Network and government which investigate the legislative barriers involved in moving to a circular economy.

Footnotes and Resources

Footnotes

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18. Redesigning the Future, RSA Event, 11 April 2013 www.thersa.org/events/audio-and-past-events/2013/redesigning-the-future

Resources

> Website: greatrecovery.org.uk

> YouTube: youtube.com/greatrecovery

> Pinterest: pinterest.com/greatrecovery

> Twitter: @Great_Recovery

> www.innovateuk.org/competition-display-page/-/asset_publisher/RqEt2AKmEBhi/content/resource-efficiency-new-designs-for-a-circular-economy

> Geevor Tin Mine – www.geevor.com

> Closed Loop – www.closedlooprecycling.co.uk

> SWEEEP Kuusakoski – www.sweeepkuusakoski.co.uk

> S2S – www.s2s.uk.com/group.html

> Aldersgate Group - www.aldersgategroup.org.uk

> Cat Reman – catreman.cat.com

> LMB Textiles – www.lmb.co.uk

> Sheffield Hallam MERI – www.shu.ac.uk/research/meri

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Bright Sparks
> Diye Wariebi,
> O'Neill Howell

www.thomasmatthews.com

Great Recovery Panel
> Jamie Burdett
> Dr. Michael Pitts
> Judith Sykes
> Dan Epstein
> Julie Hill
> John Whittall

RSA Great Recovery Advisory Panel
> Nick Parker
> Keith Read
> Carol Jackson
> Adam Lent

Design Observer and photographer
> Leonora Oppenheim

Those with little knowledge of a subject always ask interesting and sometimes awkward questions, which expose our own limitations of knowledge, make us think and give us a different perspective on a problem or issue that we may not have previously thought of.

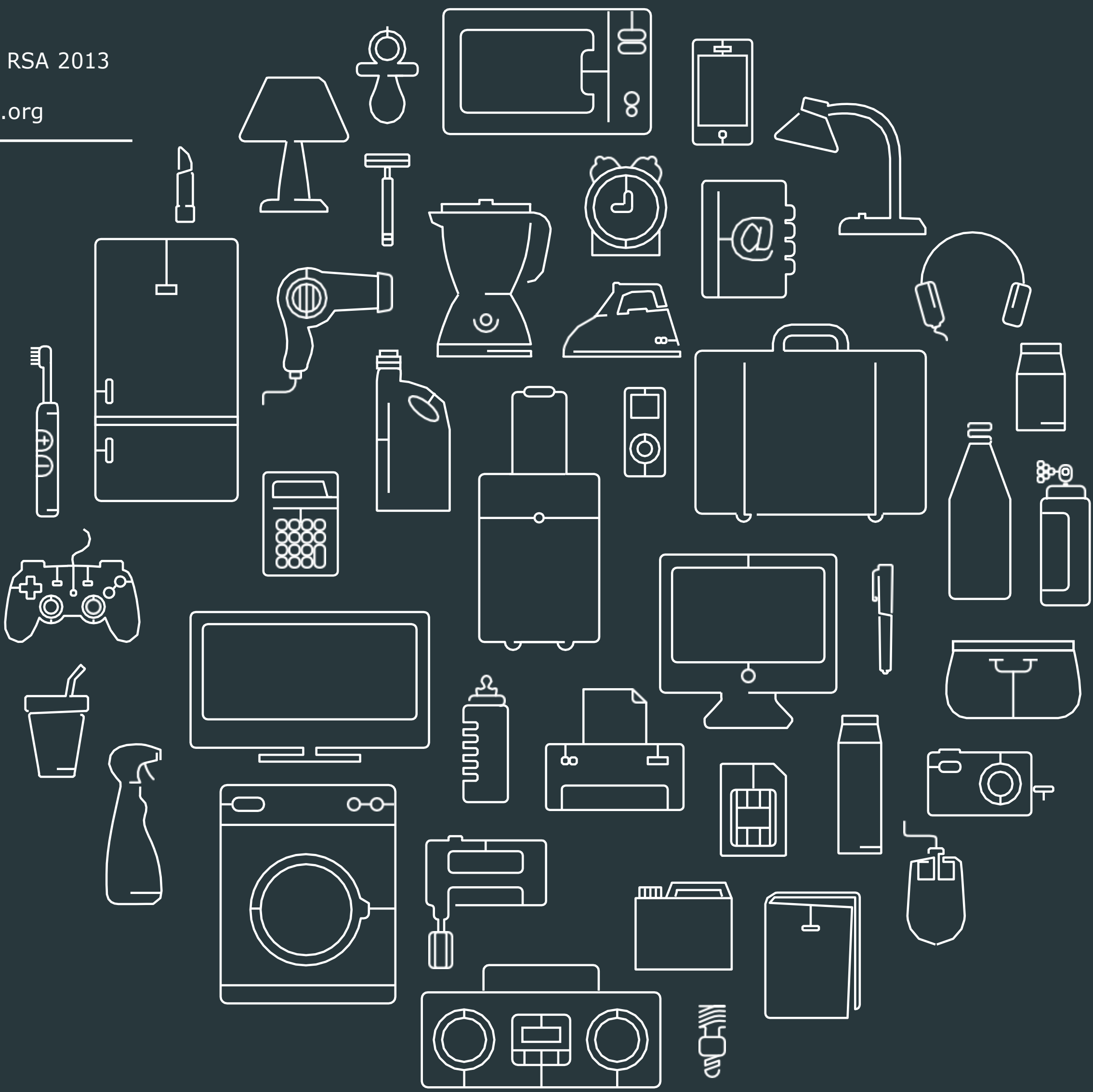
Hywel Jones
MERI, Sheffield Hallam University

RSA
Action and Research Centre

Technology Strategy Board
Driving Innovation

8 John Adam Street
London WC2N 6EZ
+44 (0)20 7930 5115

www.thersa.org



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