Just economics

CHATHAM HOUSE

Circular investment:

A review of global spending and barriers to increasing it.

Working Paper

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Acronyms

BUSD: billion United States dollars

B2B: business-to-business

CAGR: compound annual growth rate

CE: circular economy

CEG: computer generated equilibrium.

CGE : computable general equilibrium

CM: circular market

CRS: creditor reporting system

DFI: development finance institution

EFI: environmental fiscal reform

EIP: eco-industrial parks

EU: European Union

EVs: electric vehicles

FAO: Food and Agriculture Organisation of the United Nations

FMO: Dutch development finance institute

GDP: gross domestic product

IFC: International Finance Corporation

KfW: German Development Bank

LE: linear economy

LM: linear market

MEUR: million euros

MUSD: million United States dollars

NGO: non-government organisation

ODA: overseas development assistance

OECD: Organisation for Economic Cooperation

R&D: research and development

SDG: sustainable development goals

UK: United Kingdom

UN: United Nations

UNEP: United Nations Environment Programme

UNESCO: United Nations Educational, Scientific and Cultural Organisation

US: United States

W2C: waste to chemicals

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Disclaimer

Executive summary

Growing the circular economy (CE) is an attractive way to create jobs and support livelihoods, whilst reducing our impact on the planet. It has generated much interest as a route to decoupling economic growth and environmental damage. This working paper - compiled by Just Economics - aims to estimate the level and pattern of current investment in the CE relative to the linear economy. Commissioned by Chatham House[1] as background to its research paper "Financing an inclusive circular economy transition", it provides the full analysis and methodology for that paper but also acts as a standalone report to inform a set of recommendations about ways to increase investment levels - especially private investment - to the CE.

1 Funded by the MAVA Foundation project Building Transformative Alliances for an Inclusive Global Circular Economy https://www.chathamhouse.org/about-us/our-departments/energy-environment-and-resources-programme/building-transformative

Although there are many practitioner-led estimates of the economic potential of the CE, and some estimates of its share of output in key sectors, there have not - to our knowledge - been attempts to date to put a value on actual spending. This is a challenging exercise for two reasons. First, there is limited clarity around the meaning of the term, and a lack of consistency in how it is used. Second, publicly available data are limited, and spending (e.g. on environmental protection) is rarely disaggregated by circular activities. These challenges are linked of course, and current work in the EU on a circular economy taxonomy will be a welcome addition to this field.

For the purposes of this paper, we define circular investments as those that aim to narrow and slow resource flows or close resource loops. What differentiates the circular economy from general environmental spending is that it must involve changes to the level or type of material inputs to the economy, or the way these inputs are utilised or disposed of.

The analysis focuses on investments in these areas by three of the economy's main actors: governments, corporations, and financial institutions. The research was largely desk-based but a small number of interviews were conducted with public and private financial institutions to inform the findings and recommendations. We drew on a combination of official and industry data sources, though the former were more limited. Table 1 summarises the spending areas/actors for each sector.

Table 1: Spending areas included in the analysis

Sector	Spending area
Government	Waste recycling Energy efficiency Circular R&D International development New initiatives Economic stimulus packages
Corporate	Consumables Automotives Waste Food and drink Agriculture Mining and extractives
Financial	Private finance institutions Development finance institutions

Although this is by no means a complete list, we believe it covers the most material areas/actors within each sector. That said, the figures presented here should be seen as illustrative, and are intended to highlight trends and comparisons in terms of orders of magnitude rather than precise measurements. As described above, there are fundamental problems estimating circular economy spending, particularly due to different definitions and major data gaps. Despite these issues, however, we believe that the data presented here contain sufficient information to make a contribution meaningfully to the debate.

With these caveats in mind, we present an estimate of spending for each stakeholder group in Table 2.

Table 2: Summary of global spending by sector in 2019/20

Sector	Circular economy estimate ($ billion)
Government	636
Government (less stimulus)	510
Corporate	800
Finance	46
Total	**1,482**
Total (less stimulus)	**1,356**

Although it is not meaningful to compare circular with linear economy spending in every sector, we can nonetheless usefully put this into context. Global government spending in 2019 was about USD12 trillion, suggesting that 4% of government spending is circular. This is 5% when stimulus spending is included (based on an annual estimate of circular elements). The value of the corporate sectors included in Table 1 is about USD35 trillion annually, suggesting that the circular proportion of this is about 3% annually. While the financial sector is more difficult to compare, to put the figure in Table 2 in context, the value of assets managed by the 500 largest asset managers alone was more than USD100 trillion in 2019.

An important observation from the research was that spending is an imperfect measure of size or scale in a positive sense. For governments, for example, spending on waste is largely defensive as in most cases it signifies an increase in volume of waste, rather than a shift to circular models. For corporates, we distinguish between spending on transitioning core business (from non-recyclable/resource-intensive activities) to more circular activities, and changes to ancillary activities/services. These refer to the way in which the core business is delivered such as the level of energy intensity or packaging used. In many cases the volume of investments in the latter outweigh the former even though they are less likely to be environmentally valuable.

A full analysis of the costs and benefits of a circular economy transition includes financial losses as well as gains and takes account of the fact that these will be unevenly distributed by sector and geography. The costs of the transition are also substantial, and these factors partly explain why it still makes up such a small proportion of the total economy.

There are two means by which a transition to a more circular economy can take place: a) moving existing businesses away from linear activities, and b) creating new circular business models that outcompete incumbents. Both processes should be encouraged by governments and a series of regulatory and economic incentives are required to support this. First, subsidies for linear economy activities – e.g. fossil fuels – need to be removed. Second, governments should implement robust legislation across value chains to make sustainable product design the default option, ensuring that products stay in use for longer, are repairable and fully recyclable. Third, the tax system should be designed to provide strong incentives for businesses through Environmental Fiscal Reform strategies adapted to promote the CE. Fourth, innovation needs to be encouraged to accelerate the emergence and growth of circular business models (e.g. though guarantees or blended finance mechanisms). Finally, the switch to a circular economy should be seen as a strategic priority by government, forming the centrepiece of a circular industrial policy, with policies and incentives aligned.

Over the very long-term it may well be that embracing the circular economy will be the way that companies succeed, and financial investors prosper. However, in many instances the opposite is currently true. Given the countervailing forces and vested interests involved, it seems unlikely that an incremental, market-led, or bottom-up approach will be sufficient to achieve this in a timely way. Given this, it is incumbent on governments and supranational institutions to implement holistic policies that track a clearer path to a more circular economy and accelerate progress towards it. Due to the rising costs of climate change, resource depletion and waste management, there is also a strong cost benefit rationale for doing so.

1. Introduction

This report was commissioned by Chatham House as part of research programme exploring the links between the circular economy (CE) and the SDGs, and to answer the pressing question on how to close the circular economy investment gap. The aim of this component is to estimate the size and scope of circular spending in the global economy and identify barriers to increasing investment. The report discusses spending data – and related issues – for each of the major stakeholder groups: governments, private sector companies and investors. The final major stakeholder is consumers, but this group is excluded as it is out of scope for this paper.

We begin with a discussion of the challenges inherent in this exercise, as well as previous attempts to monetise the circular economy. Parts 2 to 4 discuss government, corporate and financial investment, and give estimates in each case. In Part 4, we discuss barriers to be increasing investment in the CE, with reference to concessional financiers. We conclude with a summary of the main findings, global estimates and recommendations for increasing CE spending.

1.1 Challenges of measuring CE spending

One of the main challenges of summarising investment in circular economy activities is that actors define it differently. This issue has been flagged in the academic literature. Kirchherr et al.[2] identify 114 different definitions, and argue that weak definitions will lead to sub-optimal outcomes (e.g. where the primary objective is economic, rather than environmental). Similarly, Korhoren et al.[3] argue that practitioners frequently neglect the refuse/reduce element of their definitions because it implies curbs to consumption. Both papers conclude that limited definitions will lead to incremental improvements at best, rather than the transformational change that most observers believe is required. Given that linearity is 'baked in' to the economic system,[4] incremental change is unlikely to be sufficient to achieve a restructure along circular economy lines.

This is acknowledged by the EU, which argues that the lack of a commonly accepted definition and indicators of progress: "obstructs the development and access to finance, credit risk assessment, and transferability and replicability of projects and investments across regions and jurisdictions."[5] In response, the Expert Group of Support to Circular Economy Financing has proposed a 'sector-agnostic circular economy categorisation system' that defines categories of activities substantially contributing to a circular economy. This will contribute to the wider work of the European Commission on developing an EU Taxonomy i.e. an environmental classification system to enable the scale up of sustainable investment.[6]

Heterogeneity in how the term is used also creates several problems for any attempt to measure its size and scale, including spending levels. These are as follows:

1. Some activities may be positive from a CE perspective but are not defined as such by those engaged in them. A common example is improving the energy efficiency of homes, which is sometimes classified under infrastructure spending.
2. Other activities may be labelled under a CE banner but have linear elements to them. Waste to energy schemes are considered a 'last resort' circular solution but different technologies produce different environmental outcomes, and some definitions exclude these approaches, for example the definitions used in European Union policies.
3. Unless explicitly described as such, CE investments are often not clearly identifiable. In some instances – recycling projects, for example – the CE link is obvious. In others, however, an activity can be undertaken on a circular or linear basis: e.g. houses can be retrofitted using non-linear materials.
4. CE can be either interpreted too narrowly (e.g. as a synonym for recycling) or too widely, (e.g. all environmental/sustainability investments are labelled as CE).

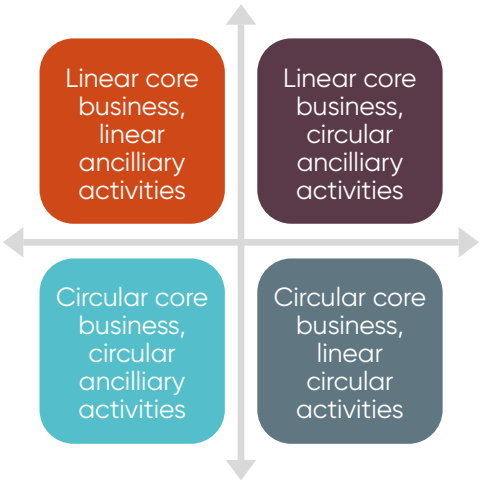
McCarthy et al. (2018) describe the spectrum of definitions from closing resource loops through to narrowing resource flows and their effects. In our analysis, we have included activities across this spectrum to ensure that all impacts are being considered. For example, in the corporate sector, we advocate distinguishing between linearity/circularity in core and ancillary business activities. Specifically, a food and drink company might invest in circular packaging, whilst leaving its core product (a highly processed and calorific meat product) untouched, or a mining company might power its trucks using

2 Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, conservation and recycling, 127, 221-232.
3 Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: the concept and its limitations. Ecological economics, 143, 37-46.
4 https://www.circle-economy.com/resources/the-circularity-gap-report-2019
5 https://circulareconomy.europa.eu/platform/en/knowledge/categorisation-system-circular-economy-contribution-future-eu-taxonomy
6 https://www.whitecase.com/publications/alert/eu-taxonomy-answer-question-what-green

renewable energy but carry on with a highly extractive core business in ecologically sensitive areas. The impact of the investments in these scenarios may even be counterproductive – e.g. where consumers consider packaging low impact and consume more of the product as a result. The concept of 'greenwashing' has been with us for some time, but as we will see, the risks are especially acute in the circular economy sphere.

One way of unpacking this would be to classify businesses according to the matrix set out in Figure 1. Whilst the bottom left quadrant will obviously achieve the highest impact, many businesses are aspiring to locate within the top right quadrant as it requires fewer changes to their traditional profit lines.

Figure 1: Investment impact matrix

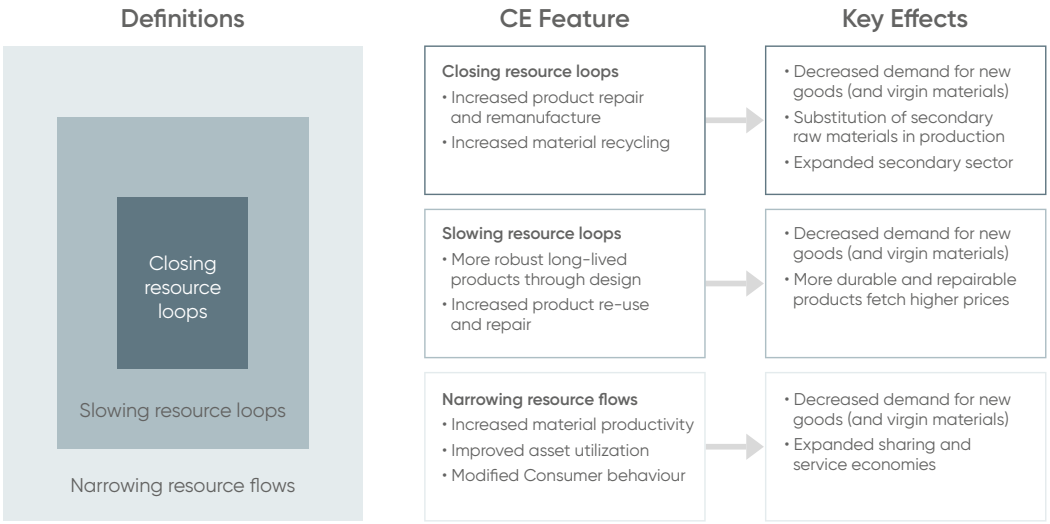


A second way in which spending may not be a good measure of change is that some of the most impactful changes may require legislative or cultural changes and cannot be captured in financial terms. Finally, some forms of spending in the circular economy could be considered defensive (i.e. more of it signifies a decrease in our welfare). Waste is a good example where an increase in spending generally occurs because we are producing more of it.

In addition to the challenge of identifying what constitutes a circular investment, there is a paucity of data on CE investment in terms of overall level, composition, and trends over time. This is partly because of the definitional problems and partly because there is no dedicated institution that is gathering and/or categorising these data sectorally, and geographically. It is beyond the scope of this study to address this fully of course, but by highlighting the difficulties in analysing the CE from an investment perspective, we hope to support wider work on developing consistency in definitions and their usage.

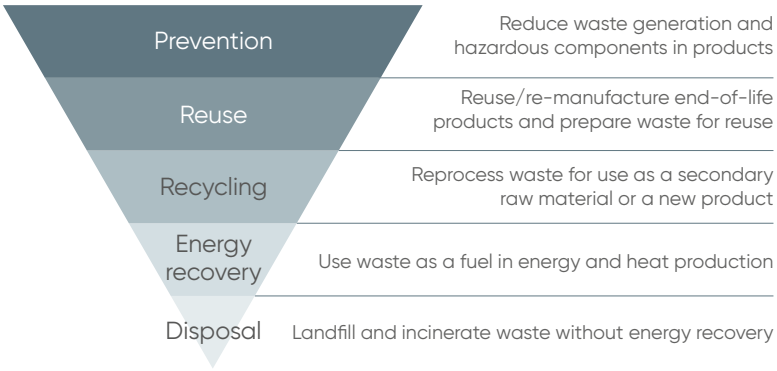
In our analysis, we have been guided by the framework set out in Figure 2 and have sought to identify investments that aim to narrow and slow resource flows, or close resource loops. What differentiates the circular economy from general environmental spending is that it must involve changes to the level or type of material inputs to the economy, or to the way these inputs are utilised or disposed of. Our definition does not include therefore renewable energy, sustainable transport, or investments in biodiversity conservation.

Figure 2[7]: Defining the circular economy



As we will see, corporate and government spending is generally focused most heavily on closing resource loops, which as the OECD waste hierarchy (Figure 3) implies may result in only limited overall environmental improvement. The wider activities of slowing and narrowing resource loops may lead to a decrease in demand as people refuse, reuse or share.[8]

Figure 3: OECD waste hierarchy



For linear core businesses in particular, the circular economy concept may represent a substantial challenge irrespective of investment in closed loop activities. Whilst most studies still find that macro-level impacts are generally small, and in many instances positive, there are several unknowns about the circular economy. For example, the relationship between increased efficiency and resource use is unclear (i.e. implications of the Jevon's effect). Also, much of the existing literature does not address the substitutability of natural capital.[9] This takes account of the fact that the loss of some forms of natural capital such as non-renewable resources is irreversible and should be treated differently. We might consider tropical rain forests, peatlands, certain minerals and metal ores in this category as they cannot be easily recycled, regenerated, or substituted by synthetics.

In the next section, we discuss previous attempts to measure the size and scale of the CE.

7 https://www.oecd-ilibrary.org/sites/f5670a8d-en/index.html?itemId=/content/component/f5670a8d-en

8 https://www.oecd-ilibrary.org/sites/f5670a8d-en/index.html?itemId=/content/component/f5670a8d-en

9 https://sustainabledevelopment.un.org/content/documents/6569122-Pelenc-Weak%20Sustainability%20versus%20Strong%20Sustainability.pdf

1.2 Previous work on estimating investment in the CE

Research for this paper has not identified any attempts to measure total spending in the circular economy to date. Circle Economy provide an annual estimate of the material size of the circular economy, estimated in 2021 to be 8.6% circular (down from 9% in 2020).[10] From a financial perspective, there have been several attempts to measure the size of the economic opportunity that the circular economy presents to different sectors over the next few years and decades. These are mainly practitioner-led analyses, and a selected number of estimates are summarised in Table 3.

Table 3: Valuations of CE potential (MUSD)

Organisation	Value (MUSD)	Unit/sector
McKinsey	$2,140,000	Whole economy
World Economic Forum	$5,350,000	Whole economy
World Economic Forum	$340,000 – 380,000	
Closed Loop Partners and Closed Loop Foundation	$2,000,000	Manufacturing
Closed Loop Partners and Closed Loop Foundation	$7,000	Recycling
Danish Ministry of Environment and Food[11]	$713-$1,740	Savings on raw materials and manufactured goods
McKinsey	$2,140,000	Whole economy
Accenture	$25,000,000	Whole economy
Veolia	$1,960	Whole economy
Circular Fashion Report[12]	$5,000,000	Fashion
PS consulting[13]	$12,000,000	Plastics
Ellen MacArthur Foundation[14]	$1,180,000	Whole economy
ESA, 2013[15]	$14,000	Whole economy
TNO, 2013[16]	$8.680	Whole economy
TNO, 2013	$1,000 per year	Waste
European Commission	$1,100	Waste
European Commission	$32,000	Paper and cardboard
McKinsey (2011)	$145,000	Iron and steel efficiency
McKinsey (2011)	$132,000	Steel efficiency
European Commission	$1,720	Mobile phone
European Commission	$1,730	Light commercial vehicles
WRAP	$385,000 by 2030	Resource efficiency initiatives
WRAP	$99,000 by 2030	Resource efficiency initiatives
C&A Consulting	$51,000 by 2023	Fashion resale market
C&A Consulting	$2,000	Fashion rental market
Ellen McArthur Foundation	$605,000	FMLG
Ellen McArthur Foundation[17]	$10,000,000	Whole economy

10 https://www.circularity-gap.world/2021#downloads
11 https://www2.mst.dk/Udgiv/publications/2016/06/978-87-93435-86-5.pdf
12 https://www.circularfashionsummit.com/circular-fashion-report-2020
13 https://www.paconsulting.com/insights/2019/Sustainable-innovation-in-plastics-and-packaging/
14 https://www.paconsulting.com/insights/sustainability/circular-economy/
15 https://www.eesc.europa.eu/resources/docs/scoping-study.pdf
16 https://www.eesc.europa.eu/resources/docs/scoping-study.pdf
17 Ellen MacArthur Foundation. (2020). Financing the circular economy: Capturing the opportunity (pp. 12-49).

As we can see, many of these estimates are far from coherent (i.e. where benefits to one sector are higher in one estimate than whole economy benefits elsewhere). This is undoubtedly due to different methodologies and assumptions being used but again a lack of definitional consistency may also be to blame.

A further problem with these approaches is that they tend to focus on the investment opportunity and potential material cost savings, but not the costs of implementing circular solutions - resulting in a positive bias. Most notably they tend not to include the economic losses from refuse/reuse/sharing activities that may displace economic activity. One way of approaching the question on a symmetrical basis is to model the impacts globally using computable general equilibrium (CGE) modelling. McCarthy et al. (2018) have reviewed the studies on the macroeconomic impact of moving to a circular economy for the OECD[18] and find that most conclude that this can take place without significant negative impacts, or even positive impacts. Four studies found that the transition could result in gains of 5% of GDP (or $4.4 trillion), but these are the most positive studies in the literature. Given that these estimates contain all the multiplier effects resulting from investments through economic systems, we would expect them to be many times greater than the investment potential estimates in Table 2. The fact that this is not the case, highlights the point that most (practitioners' or proponents') estimates of potential economic opportunities do not take account of the accompanying costs.

Within these global estimates, there are also important distributional impacts. Countries that specialise in extractive sectors (mining, oil and gas, agriculture, fishing and forestry), and material transformation sectors (metal smelting and fuel refining) are likely to emerge worse off, most notably Russia, Brazil and Canada, but also developing country economies that are heavily dependent on primary resource exports As we will see, it is not surprising that these economies are not major investors in the circular economy to date, although this may be starting to change. Within economies, there will also be major distributional effects, focused on changes to employment patterns in circular vs. linear sectors.

1.3 Methodology

This research was largely desk-based, although a small number of targeted interviews were also carried out. We began with a review of the existing literature on the CE. This is largely a grey literature, however, there is a growing number of academic papers on the subject. Few of the latter dealt with spending or investment, and most of the data used here is from industry/NGO sources. We have used both top-down and bottom-up approaches to accessing data. For the former, we identified spending/investment areas relevant to the CE (waste management, energy efficiency and so on) and collated global estimates compiled by other organisations. For the latter, we conducted internet searches for particular countries, companies or economic institutions with the largest economic or environmental footprints using key search terms (e.g. circular construction + investment). For some corporates, the annual reports of key actors were accessed to extract data. Data for the SDG analysis was drawn from the OECD's SDG Financing Lab.[19]

There are several caveats and limitations to the data presented. First, there were significant data gaps and the amounts presented may underestimate the scale of

18 https://read.oecd-ilibrary.org/environment/the-macroeconomics-of-the-circular-economy-transition_af983f9a-en#page50

19 https://sdg-financing-lab.oecd.org/

the circular economy as not all spending will be announced or made public and the definitional issues set out above may mask some spending. On the other hand, there is an important materiality issue to consider, and it may be that the most significant investors/spenders are captured meaning that a full data set would not lead to greatly different estimates. Second, the report relies heavily on grey literature, industry, and practitioner data sources. It has not been possible to investigate the robustness of these sources and they should therefore be treated with caution. Third, some of the items that have been included have been derived from global estimates (e.g. green bonds, green cement or energy efficiency). We have had to make assumptions about the proportions that are likely to be circular, while we have made every effort to be as accurate as possible, these should also be treated with caution. Fourth, although we have distinguished between sectoral investment sources (e.g. EU and corporate funding) this is challenging and there remains a risk of double counting.

Despite these caveats, we believe the data presented here give a useful indication of the scale and pattern of current CE spending, including how it compares with investment in the linear economy. As we will see, investment levels are well below where we would expect them to be if we are to believe much of the publicity about the CE, and further still behind where they would need to be to deliver real change.

To conclude, due to the limitations listed above, we recommend that the data presented here are used for illustrative purposes only. This paper would benefit from being developed over time so that CE spending can be effectively tracked in a systematic way sectorally at both national and global levels.

The next chapter discusses investment by stakeholder, beginning with governments.

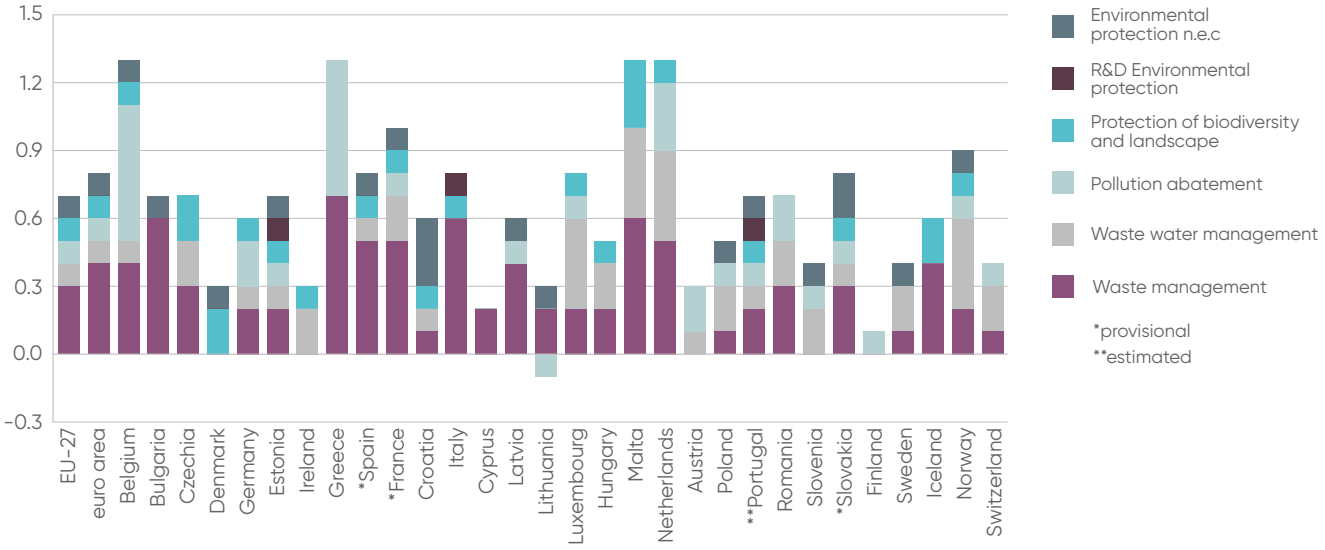
2. Government spending

Two approaches were used to estimate public sector spending. The first was to take elements of the circular economy – waste management, energy efficiency and so on - and identify estimates of global spending in the literature. The second was to take a country/institutional level analysis – i.e. to identify the largest country investors and track public announcements in aspects of the circular economy, or in transitions towards the circular economy. The first approach tracks general government spending on ongoing issues, while the second covers new announcements to augment a transition to a circular economy through R&D or new initiatives. We do not expect much double counting across the two estimates, therefore.

2.1 Global estimates

As discussed above, governments tend not to account for circular spending as a subset of their total environmental spending. Figure 4 shows a breakdown of environmental spending for EU countries as a share of GDP.

Figure 4: Total general government expenditure on environmental protection (Eurostat)



Of these, it is only waste management (and some elements of R&D that will be relevant to this discussion). In addition to **waste recycling** and **R&D**, we identified estimates for global spending on **energy efficiency** and **international development**. This is far from an exhaustive list, but due to the challenges of identifying CE spending within government budgets, only these categories can be reliably included.

1. Waste and recycling

As discussed, many governments only classify waste disposal/recycling as circular spending. Whilst limited, as dealing with only one part of the waste hierarchy, it makes up a substantial portion of total environmental spending, not to mention circular spending. Governments have generally been increasing their spending on waste management, but this is because most countries are generating increasing amounts of waste; only a few have managed to decouple total waste generation (i.e. all sources of waste) from population and economic growth.[20] Although increased growth generally leads to more waste, it also leads to more pro-environmental policies and there is also a correlation (within EU countries) between higher GDP and number of patents in the circular economy.[21]

According to the UNEP, global waste management expenditures are approximately 0.5 percent of global GDP (estimated at approximately $442 billion in 2019). This is a significant cost that is largely met by governments, especially local governments where it can account for 20%-50% of operational spending. [22] It is also a significant proportion of overall government spending. For example, in 2019, the UK spent 0.3% of GDP on waste,

20 https://www.oecd-ilibrary.org/sites/f5670a8d-en/index.html?itemId=/content/component/f5670a8d-en#section-d1e3572

21 Sverko Grdic, Z., Krstinic Nizic, M., & Rudan, E. (2020). Circular economy concept in the context of economic development in EU countries. Sustainability, 12(7), 3060.

22 https://www.imf.org/en/Publications/WP/Issues/2019/12/20/Disposal-is-Not-Free-Fiscal-Instruments-to-Internalize-the-Environmental-Costs-of-Solid-Waste-48854

which corresponds to 1% of its total public sector budget.

Table 4 gives a global breakdown of waste disposal by method.

Table 4: Solid waste management globally

Waste disposal	Percentage
Incinerated	37
Landfill	11
Recycled	19
Open dumping	31

Source: World Bank[23]

We can use these data to generate an estimate of global operational spending on circular waste. If we assume that open dumping has no direct economic cost, we can remove this from the calculation, so costs are spread between recycling, incineration, and landfill. Only recycling can be considered circular, giving a total cost of $121 billion (27% of total cost). There are several caveats. First, we assume the cost of disposal by type is constant but may in fact vary. Second, governments also raise revenues through environmental taxes that partly offset these costs (although they tend to be lower than expenditures even in OECD countries).[24] Finally, what counts as recycling may vary and the circularly of these activities may vary. Nonetheless, it is a reasonable proxy for global spending on waste recycling. This figure is limited to public expenditure on waste and the wider waste market will be considered in Section 3.

2. Energy efficiency

According to the IEA, a total of $250 billion was invested in energy efficiency across the building, transport and industry sectors in 2019. This did not change much from the previous year despite signs of new activity in some areas, though public spending on R&D relating to energy efficiency grew 12% to $4.5 billion.[25] In addition, the IEA has tracked $66 billion of funding for energy efficiency-related measures announced as part of governments' stimulus packages to the end of October 2020. A large share ($26 billion) has been allocated to the buildings sector. Around $20 billion has also been announced to accelerate the shift to electric vehicles, including for new vehicle charging infrastructure. Spending announcements from European countries (86%) dwarf those from other parts of the world, however, these exclude the recent stimulus packages introduced in the US.[26]

3. R&D

Unfortunately, globally R&D spending on the CE is not tracked by any international institution. The OECD has tracked total R&D spending on environmental protection to 2013. Total public sector R&D spending had decreased following the 2007/8 financial crisis but environmental R&D recovered at a faster rate that total public R&D in the years following it. In 2013, it represented $4 billion, or just 2% of total R&D in the OECD area.

23 https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html

24 https://www.imf.org/en/Publications/WP/Issues/2019/12/20/Disposal-is-Not-Free-Fiscal-Instruments-to-Internalize-the-Environmental-Costs-of-Solid-Waste-48854

25 https://www.iea.org/reports/energy-efficiency-2020/energy-efficiency-in-2019

26 https://www.iea.org/reports/energy-efficiency-2020

There are large country differences: Germany, Japan and the United States are the largest funders, while New Zealand and Australia are the top investors in relative terms. It is not known what proportion of this is CE funding specifically, but it does exclude renewable energy, which is counted as part of energy R&D (of which it makes up 24%).[27] According to UNESCO, global R&D spending is $1.7 trillion. Assuming this 2% holds in 2019, this gives us a global estimate of $34 billion. If we assume that one-third of this is CE-related, this gives is a global estimate of $10 billion.

4. International development

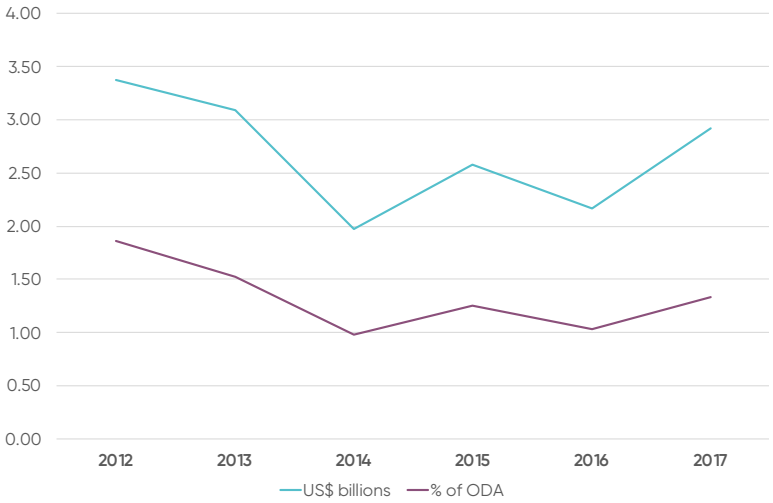
The estimates above largely relate to investments within developed countries by their own governments. This is particularly the case for the EU sources. An equally important issue is progress in developing countries. Once set, development trajectories are difficult to change. Infrastructure and manufacturing facilities have long lifetimes and are unlikely to be replaced until they have operated for many years, often decades. Given this, influencing these trajectories at an early stage may be the best way of hard-wiring CE approaches into industrialisation pathways of the evolving world economy. High-income countries can influence these issues through Overseas Development Assistance (ODA). What can we learn about the importance they place on CE issues through their allocations of ODA? The best source of data on the pattern of donor spending is the OECD-DAC, which maintains a detailed database of ODA commitments and disbursals – the Creditor Reporting System (CRS). Although there are detailed codes to categorise ODA activities, these do not correspond to CE categories in any way that could be analysed. An alternative would be to go through the CRS and analyse the descriptions of interventions, linking these to the CE. While this would be ideal, there are more than 250,000 activities in the CRS database, making this practically impossible.

While the CRS has not been analysed with respect to the CE, interesting work is ongoing to link ODA to the SDGs. A recent change to OECD-DAC reporting links interventions with particular SDGs when reporting to the CRM. This is voluntary, however, and only relevant to the most recent ODA allocations. To address this, the OECD SDG Financing Lab has developed a machine-learning algorithm to analyse CRS descriptions and link these to one or more SDGs. Although the SDGs do not map perfectly onto CE categories either, there is some overlap. Most importantly, SDG 12 concerns 'sustainable production and consumption', which is obviously core to the CE. Although not the only SDG addressing circular issues, it is a reasonable starting point for the importance that donors place on this in their ODA strategies.

Figure 5 looks at total annual ODA flows that can be associated with SDG 12 on an annual basis, from 2012 to 2017. In nominal US dollar terms, this ranges between $3.5bn and $2 bn, and shows no sign of an upward trend over the period. Looking at the share of ODA that can be associated with one or more SDG, the figure is between 1% and 2%, again with no sign of an upward trend. Cumulatively over the period, the total ODA investment was US$16.1 billion.

27 https://www.oecd-ilibrary.org/docserver/9789264235199-21-en.pdf?expires=1617031890&id=id&accname=guest&checksum=6FE9E8F497BC5FC3D3C48DDD5686B593

Figure 5: Annual ODA spending on SDG 12 & % of total ODA



Source: SDG financing lab

Table 5 compares SDGs between 2012 and 2017 on a cumulative basis. As we can see, SDG 12 is ranked 16th out of the 17 SDGs, with only SDG 14 (life below water) receiving a lower allocation of ODA spend. As mentioned, there will be interventions of relevance to the circular economy in other SDGs, particularly SDG 11 (sustainable cities & communities), but also SDGs 14 and 15 (life below water and on land) and SDG 6 (clean water and sanitation). More disaggregated information on circular spending for these SDGs, but also for SDG 9 (industry, innovation and infrastructure), which has attracted the largest share so far, is not available.

Table 5: SDGs ranked by ODA allocations (2012-2017)

Rank	SDG	% ODA 2012-17
1	Industry, innovation and infrastructure	10.64
2	Good health and well being	10.60
3	Peace, justice and strong institutions	8.91
4	Zero hunger	8.74
5	Partnerships for the goals	8.70
6	Reducing inequality	8.43
7	Affordable and clean energy	7.60
8	Quality education	7.40
9	Sustainable cities and communities	6.02
10	Decent work and economic growth	5.79
11	Clean water and sanitation	4.73
12	Climate action	3.32
13	No poverty	3.20
14	Life on land	2.09
15	Gender equality	1.60
16	Responsible consumption & production	1.32
17	Life below water	0.92

Our next consideration is which donors are most likely to prioritise the circular economy. Table 6 contains all donors that contributed more than 1% of ODA to SDG 12 between 2012 and 2017, as well as the largest recipients. The largest donors were the EU (18%), Germany (15.8%), the UN (14%), IDA (9.4%) and Japan (8.5%).

To some extent, these rankings reflect the size of the donor agencies, and other countries that clearly prioritise these issues are Belgium, Finland, Austria and New Zealand. Despite being small countries, they appear as significant SDG 12 donors when much larger countries do not.

Table 6: Donors and Recipients of circular economy ODA (2012-17)

Donor			Recipient		
	BUSD	% ODA to SDG 12		BUSD	% ODA to SDG12
EU Institutions	2.86	17.98	Vietnam	1.47	13.95
Germany	2.52	15.83	Bilateral, unspecified	1.37	12.98
United States	2.22	13.98	Egypt	0.92	8.72
IDA	1.49	9.37	Jordan	0.68	6.46
Japan	1.34	8.44	Turkey	0.55	5.26
ADB	0.93	5.86	China	0.51	4.84
France	0.77	4.81	India	0.43	4.08
GEF	0.48	3.03	Ukraine	0.41	3.85
Canada	0.48	2.99	Afghanistan	0.32	3.02
Norway	0.41	2.59	Tanzania	0.31	2.94
Korea	0.27	1.7	Sub-Sahara regional	0.30	2.83
Netherlands	0.24	1.52	Cambodia	0.26	2.50
United Kingdom	0.23	1.42	Peru	0.26	2.48
Switzerland	0.23	1.42	Nigeria	0.26	2.47
IADB	0.19	1.17	Ethiopia	0.25	2.37
Sweden	0.17	1.04	Georgia	0.25	2.34
Australia	0.16	1.02	Nepal	0.25	2.34

For recipient countries, the largest by far was Vietnam, which received around 14% of all ODA linked to SDG 12. The next largest recipient countries were Egypt (8.72%), Jordan (6.46%), Turkey (5.26%), China (4.84%) and India (4.08%). Given the economic characteristics of these countries, it seems likely that ODA is being focused on increasing the sustainability of existing and/or new production facilities, by moving them in a more circular direction.

3.2 Country-level analysis

In this section, we discuss the country level findings. As we saw in Figure 4, waste and water management make up most of environmental spending by governments. Routine spending such as this has been excluded from the country level analysis to avoid double counting. Instead, we have focused on areas of additional spending such as new R&D announcements, transition funding or green stimulus spending. For EU economies we

have endeavoured to identify spending from national budgets to avoid double counting EU funds.

The main public investors in the circular economy are the European Union (as an entity), individual EU economies (especially Germany and France), Japan and China. Recent developments in the US will most likely result in the US being a significant environmental spender, although the implications for the circular economy from this are still unclear. We begin with a discussion of the EU before going on to explore the circular elements of pandemic stimulus funding, followed by a discussion of additional spending announcements in the rest of the world.

European Union

The EU has channelled 10 billion of funding to circular economy projects (2016-2020). This includes:

- €7.1 billion through the Cohesion Fund (€1.8 billion for uptake of eco-innovative technologies among SMEs and €5.3 billion to support the implementation of the EU waste legislation)
- €1.4 billion from Horizon 2020 until 2018 (on areas such as sustainable process industries, waste and resource management, closed loop manufacturing systems or the circular bioeconomy), among which € 350 million are allocated to making plastics circular.
- €2.1 billion through financing facilities such as the European Fund for Strategic Investments and Innovfin.
- At least €100 million invested through LIFE in more than 80 projects contributing to a circular economy.

The EU's Circular Economy Action Plan identified five sectors (plastics, food waste, critical raw materials, construction and demolition, biomass and bio-based materials) to prioritise.[28] Member states have also pledged considerable sums to support transitions internally. Table 7 provides some of pre-pandemic national government announcements.

28 https://www.bitc.ie/newsroom/the-business-case-for-the-circular-economy/

Table 7: EU member state investments

Member state	Amount (MEUR)	Details
Germany	€4,000	Research for Sustainability (FONA) Strategy, which include circular economy
	€5,000	Retrofitting
France[29]	€1,800	Circular Economy Fund implemented since 2009 by the ADEME
Poland[30]	€4.5	Energy efficiency
Belgium	€12.8	Be Circular Programme
Denmark	€16[31]	To fund national strategy towards a CE
Netherlands[32]	€40	Investment in circular economy-related projects in 2019 and 2020,
	€400	Retrofitting rented houses[33]
	€600	National energy saving fund[34]
Total	€11,860	
Total (USD)	$14,000	

Pandemic stimulus packages

As of February 2020, Governments have announced the $14.9 trillion in public stimulus spending to offset the economic effects of the pandemic. An analysis by Vivid Economics of stimulus spending found that it was more heavily tilted towards measures that will be net negative for the environment, including higher subsidies for fossil fuels than renewable energy. [35] In total only 12% of the spending announcements were environment-related ($1.78 trillion). The analysis does not include the US green infrastructure or stimulus bills (totalling about $3.9 trillion of which at least half is on environmental spending, more than announced by the rest of the world). Writing before the bills were passed, the analysts acknowledge that if even a proportion of the initial stimulus bill was passed ($1.9 trillion), it would have a powerful transformative effect on the US economy.

The analysis also shows that the environment was a much higher priority for some countries than others (see Table 8 for some examples). No CE breakdown was provided but in general there was a greater emphasis on renewable energy and transport. Of the 22 countries included (plus the EU), only 4 – the EU, France, Korea and Canada – are spending on positive waste policies, and 2 countries - the US and the UK are spending on negative waste policies. Energy efficiency features in many of the plans but a breakdown of this figure was not available.

A major caveat to these, and all government spending announcements is that these are often repackaged from previous announcements. There is a risk that they double count therefore with other commitments listed in this section. For example, of the £12 billion green stimulus announcement made by the UK in 2020, only £4 billion was new funding.[36] In Table 8, we detail the announcements on stimulus/green spending and provide an estimate on the proportion that is circular. In general, we assume a higher proportion is circular in EU economies where the CE is a higher policy priority.

29 https://www.ademe.fr/sites/default/files/assets/documents/eng_-_ademe-brief-assessment-waste-fund-2019.pdf

30 http://www.nfosigw.gov.pl/o-nfosigw/strategia/

31 https://stateofgreen.com/en/partners/state-of-green/news/financing-the-circular-economy/

32 https://www.eesc.europa.eu/resources/docs/scoping-study.pdf

33 https://www.government.nl/documents/publications/2013/09/06/energy-agreement-for-sustainable-growth

34 https://www.government.nl/documents/publications/2013/09/06/energy-agreement-for-sustainable-growth

35 https://www.vivideconomics.com/wp-content/uploads/2021/01/201214-GSI-report_December-release.pdf

36 https://www.iisd.org/sustainable-recovery/news/uk-government-outlines-10-point-plan-for-a-green-industrial-revolution/#:~:text=On%20November%2017%2C%202020%2C%20the,electric%20vehicles%2C%20and%20renewable%20energy.

Table 8: Circular spending estimates of governments' green stimulus packages (multi-year)

Country	Total green stimulus spending ($ billion)	Purpose	Circular spending estimate ($ billion)
EU	$269	Amounts to some 30 per cent of the EU's total stimulus spending.	$183
Germany	$59.8[37]	This 'future package' of investment, with a focus on the transition to a greener economy, and allocations for research in areas such as artificial intelligence and quantum computing. Huge sums will be spent on expanding Germany's charging infrastructure for electric cars.	$29
China	$1.4[38]	Amounts to 0.3 per cent of China's total stimulus spending.	$0.35
UK	$1.37	Green homes and public sector decarbonization.	$1.37
	$0.48[39 40]	Circular activities include cutting emissions from heavy industry; reuse/recycling and innovative materials in industry and construction; efficient battery technology. (Includes $31 million for circular textiles and construction materials.)	$0.48
Spain	$8.13[41]	Total net green investments in 2021	$8
South Korea	$161[42]	Includes $17.3 billion from the private sector. Will cover renewables, electric vehicles and a circular economy element (although breakdown not available).	$39
France	$36[43]	€7 billion for retrofitting homes; €4 billion for public buildings; €7 billion for clean tech and business; €1.3 billion for biodiversity; €1.2 billion for green agriculture.	$22 (all earmarked for circular economy projects)
Canada	$4.7	Home insulation, green transport and clean energy.	$1.56
US	$480	Amount of green fund allocated for manufacturing subsidies and R&D.	$160
	$561	Amount of green fund allocated for green housing, schools, power and water upgrades (including many builds).	$187
	$1,900	Rescue package.	unknown
India	$0.83	Green economy.	$0.28
Total (multiyear)			**$632**
Total (annual estimates)			**$126**

37 Chazan, G. (2021), 'German stimulus aims to kick-start recovery 'with a ka-boom'', Financial Times, https://www.ft.com/content/335b5558-41b5-4a1e-a3b9-1440f7602bd8.

38 Larsen, K,, Larsen, J., Chaudhuri, P., Kirkegaard, J. and Wright, L. (2021), 2020 Green Stimulus Spending in the World's Major Economies, Rhodium Group, 2 February 2021, https://rhg.com/wp-content/uploads/2021/02/2020-Green-Stimulus-Spending-in-the-Worlds-Major-Economies.pdf

39 UK Government (2020), 'PM commits £350 million to fuel green recovery', press release, 22 July 2020, https://www.gov.uk/government/news/pm-commits-350-million-to-fuel-green-recovery.

40 UK Research and Innovation (2020), 'Circular economy centres to drive UK to a sustainable future', https://www.ukri.org/news/circular-economy-centres-to-drive-uk-to-a-sustainable-future/.

41 Netherlands Ministry of Agriculture, Nature and Food Quality (2021), 'The Spanish Government allocates €766.47 million for hydraulic investments in 2021', 14 January 2021, https://www.agroberichtenbuitenland.nl/actueel/nieuws/2021/01/14/spain-the-spanish-government-allocates-%E2%82%AC766.47-million-for-hydraulic-investments-in-2021.

42 Kim, S.-Y. et al. (2020), 'South Korea's Green New Deal shows the world what a smart economic recovery looks like', The Conversation, 9 September 2020, https://theconversation.com/south-koreas-green-new-deal-shows-the-world-what-a-smart-economic-recovery-looks-like-145032.

43 Cossardeaux, J. (2020), 'Plan de relance: la transition écologique se taille la part du lion', 3 September 2020, https://www.lesechos.fr/politique-societe/societe/plan-de-relance-la-transition-ecologique-se-taille-la-part-du-lion-1238889.

Rest of the world investments

Outside of the EU, the main players are Japan, China and the UK. However, as discussed, the US may now become an important investor if the $2 trillion green infrastructure bill is passed.

Canada, as we have seen is one of the countries that will potentially lose out from a move towards a CE due to its dependence on extractive industries and natural resources. However, according to Vivid Economics data, its stimulus plan is net positive environmentally. Canada is also starting to develop policy in this area. It will be hosting the World Circular Economy Forum in 2021 and has commissioned a report on the circular economy in Canada in advance of this. Aside from the stimulus package, which focuses on home insulation, transport and green energy. there have been no major spending announcements.

China faces a range of environmental and climate change challenges unique in scale and complexity. It is a major producer of e-waste and coal still accounts for 60 percent of the energy mix.[44] China has recognised the value potential in remanufacturing and recycling in its last two five-year plans as well as the conflict between economic growth and natural resource use. China has identified several key areas for circular economy development (e.g. electronic waste, zero-waste cities, eco-industrial parks).

Table 9 summarises some of the spending we know about spending in non-EU countries.

Table 9: Examples of CE spending in non-EU countries

Country	Amount (MEUR)	Details
UK	€205	Use of innovative materials in heavy industry
	€30	Building technologies
	€2,300	Retrofitting
	€1,150	Public sector decarbonising
	€20	The Circular Economy Investment Fund
	€58	Retrofitting technologies
Australia	€2,300	Total package (including 441 million housing, 5 million oil recycling and 123 million recycling modernisation)
China	€3,500	Energy efficiency (2018)[45]
	€3,700	Waste management (2017)
	€47,000	China Development Bank investment in six eco-industrial parks
	€16,000	Zero-waste cities
US	€8,500	Office of Energy Efficiency and Renewable Energy (not all circular)[46]
	€2,000	Efficient construction (2% of the 1.4 trillion spent on construction.[47]
Korea[48]	€22	Eco-industrial parks (generates revenues of $91 billion)[49]
Vietnam and Singapore	€2,230	Eco-industrial parks
Total	€72,680	
Total MUSD	**$92,416**	

44 http://documents1.worldbank.org/curated/en/726191584947617010/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-China-Jiangxi-Eco-industrial-Parks-Project-P158079.pdf

45 https://www.iea.org/reports/world-energy-investment-2019/energy-end-use-and-efficiency

46 https://webstore.iea.org/download/direct/2829?filename=united_states_2019_review.pdf

47 https://www.iea.org/reports/world-energy-investment-2019/energy-end-use-and-efficiency

48 Unido

49 https://www.worldbank.org/en/news/feature/2018/01/23/eco-industrial-parks-emerge-as-an-effective-approach-to-sustainable-growth

Japan is particularly interesting from a circular economy perspective. A 2020 Ministry of Environment report on the size of Japan's environmental industry states that it had reached a record size of approximately 105.3 trillion JPY ($955 bn) in 2018 (a 3.1% year on year increase and accounted for 10.1% of all Japan's industry. The report estimated that the entire market will grow to a value of 133.5 trillion JPY in 2050, 40% of which would be made up of circular economy businesses. These data would suggest that the CE in Japan is currently worth somewhere in the region of $300 billion dollars. We know that government spending amounts to 37.5% of GDP in Japan, which would imply government spending of approximately $111 billion.

3.3 Conclusion

Estimating public spending on the circular economy is challenging due to a lack of consistency in how the CE is classified and a lack of appropriate breakdowns of spending on environmental protection. Moreover, there is no independent body tracking and verifying that spending announcements are implemented. It is not always clear whether figures reported are annual or multi-year, which is a further challenge to arriving at an accurate figure. Two methods have been used to gather estimates: a top-down approach that aggregates estimates of public spending on waste, R&D, international development and energy efficiency and a bottom up approach that tracks new spending announcements. These are summarised in Table 10.

Table 10: Summary of government spending

Area of spending	Estimate (BUSD)
Recycling	$121 (annual)
Energy efficiency	$250 (annual)
International development	$2.7 (annual)
R&D	$10 (annual, estimate)
Other EU spending	$14
Other non-EU spending	$92
Stimulus (multiyear estimate)	$632
Stimulus (annual estimate)	$126
Total	**$616**
Total less stimulus	**$490**

As we can see, if we look at figures for annual spending in the first four rows, we get a figure of $384 billion. When we add the multi-year government investments, this increases to over $500 billion and to over $600 billion when stimulus spending is included. Due to the multi-year nature of the stimulus spending, we have divided the total by 5, as these packages tend to be spent over several years. This amounts to about 5% of government spending (based on 15% of general government spending of a global GDP of $87.55 trillion). If we exclude stimulus spending, the percentage is about 4% of global government spending.

3. Corporate

Our analysis of corporate investment in circular economy approaches further supports the need for greater precision in defining circular economy activity. We divide our analysis into five sections.

- Consumables (fashion and electronics)
- Construction
- Mobility
- Mining and extractives
- Agriculture and food

These make up the majority of emissions and resources use (housing, mobility and food alone are 70% of emissions).[50]

50 https://www.circle-economy.com/resources/circularity-gap-report-2021

In terms of investment, we can distinguish between two types of corporation. The first is existing companies that have evolved in a linear economy and whose practices account for the 70% of emissions and resource use described above. The second is new, innovative firms that are pioneering new businesses and/or business models that are inherently circular. A transition to a circular economy can occur in one of two ways. Either incumbent firms can make the transition themselves, becoming fully circular over time, or new, inherently circular firms outcompete and replace these incumbent institutions.

The sense from the literature is that many practitioners see the latter of these two options as the desired end-state. It seems more likely that we will see a combination of some new circular businesses emerging and reaching maturity and scale, while at the same time many incumbent firms will learn and adapt. The speed of the adaptation being a function of how easy or difficult it is to achieve circularity in different sectors, which itself will be a function of the policy environment. New, innovative firms will certainly join the corporate ecosystem, and their innovations are also likely to be replicated when they are proven to work. We include some material on CE start-ups later in this section, but - despite the attention they receive in the literature - it is important to remember that this is only part of the story, and probably not the most important part either.

3.1 Consumables

The scope for change within consumables varies but there is evidence of only limited circular investment by corporations. Increased awareness around the environmental impacts of plastic pollution has increased consumer interest in reducing plastic waste, and the evidence would suggest that consumer-facing companies are responding. CDP report that most companies in household and personal care are investing in plant-based products and reduced packaging but even within this, only 14% of these innovations are being rolled out at scale.[51]

Two sub-sectors are of significant concern within consumable: textiles and electronics. For these sectors, a structural shift to the circular economy presents something of an existential crisis: no amount of reduced packaging can offset the resource use required to sustain the fashion industry, especially ready-made garments and fast fashion markets. Circular solutions need to maximise the refuse, reduce, reuse elements, which must necessitate a contraction in the size of the industry. With electronics, legislative changes such as right to repair and designing out obsolescence pose a similar challenge, as they are designed to keep products in use for longer thereby reducing demand for new ones.

Fashion

The fashion industry is a global business of 1.5 trillion dollars[52] which has been growing faster than the global economy over the past decade and is projected to continue doing so. There is lots of evidence of new business models around the resale and rental of clothing and these are attracting investment (see Table 11). Whilst strong growth is expected in these markets, they are currently worth about 0.05% of the global industry ($7 billion[53] and 1.26 billion[54] respectively in 2019). Even if we remove the $34 billion in the artisanal textile industry,[55] it is still only 0.06%.

51 https://www.cdp.net/en/investor/sector-research/consumer-goods-report

52 https://www.statista.com/topics/5091/apparel-market-worldwide/

53 https://www.alliedmarketresearch.com/online-clothing-rental-market#:~:text=Online%20clothing%20rental%20market%20size%20is%20estimated%20to%20reach%20%241%2C856,occasions%2C%20making%20it%20more%20affordable.

54 https://www.businesswire.com/news/home/20200505005656/en/Global-Online-Clothing-Rental-Market-Forecast-to-2025---ResearchAndMarkets.com

55 (U.S. African Development Foundation/Alliance for Artisan Enterprise, July 2014).

Table 11: Investments in circular fashion

Company	Industry type	Investment 2020/2021 (MUSD)
Poshmark[56]	Resale	$277
Rent the Runway[57]	Rental	$25
thredUp	Resale	$175
RealReal[58]	Resale	$5.5
Grailed[59]	Resale	$20
Depop[60]	Resale	$55
Otrium	Resale[61]	$21
Bag Borrow or Steal	Rental	$4
Farfetch[62]	Resale	$250
Wardrobe	Rental	$1.5
Flyrobe	Rental	$3.5
DyeCoo	Alternative fabrics	$19.5 (over 10 years)

Total investments in these companies were estimated to be in the region of $392 million in 2016 (based on 22 US-based start-ups).[63] Whilst this is not insubstantial, it is again a small proportion of total venture capital VC and private equity PE investment in fashion ($23 billion in 2017, or 1.7%).[64] It is also small compared with FDI investments in textiles, which are in the region of 26 billion for
the OECD.[65]

There are two mechanisms whereby circular fashion could increase its share of the global market. The first is by a huge shift in consumer demand to these new business models. However, whilst there is some evidence of changing consumer preferences in high income countries,[66] the fastest growth in luxury spending is taking place in Asia and is predicted to continue to do so. The second mechanism is through adaptations towards more circular practices by traditional fast fashion companies. In 2017, the 2020 Circular Fashion System Commitment was signed and 12.5% of the global market - including major fast fashion brands - signed up. However, the two-year progress report finds that only 21% of the 2020 targets were met.[67] These commitments are also accompanied by investment. Inditex (owner of Zara, Pull&Bear and Massimo Dutti) has invested €1.6 million in applied research related to circular economy and to the conversion of waste into raw materials. However, this is only one-hundredth of its overall sustainability programme (€1.6 billion).

There are two means by which the industry is making circular investments therefore:

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56 https://www.forbes.com/sites/laurendebter/2021/01/14/poshmark-stock-soars-ipo/?sh=19de4efe7e14

57 https://ww.fashionnetwork.com/news/Rent-the-runway-seeking-25-million-in-funding-round,1217904.html

58 https://fashionunited.uk/news/business/something-old-something-borrowed-the-rise-of-resale-and-rental-in-fashion/2020013147285#:~:text=By%202023%2C%20the%20resale%20market,little%20as%2010%20years%20time.

59 https://www.businesswire.com/news/home/20180621005084/en/Curated-Fashion-Marketplace-Grailed-Raises-15-Million-in-Series-A-Funding

60 https://www.eu-startups.com/2019/06/london-based-mobile-fashion-marketplace-depop-raises-e55-million-series-c-to-meet-rising-demand-from-generation-z/

61 https://www.indexventures.com/perspectives/otrium-raises-24m-to-extend-fashions-life-cycle/

62 https://www.retaildive.com/news/farfetch-raises-250m-to-accelerate-global-growth/571565/

63 https://www.livemint.com/Companies/jKyevMdx00yPma9XjUXe4L/Online-fashion-rentalstartup-Flyrobe-raises-53-million.html

64 https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/the%20state%20of%20fashion%202020%20navigating%20uncertainty/the-state-of-fashion-2020-final.ashx

65 https://stats.oecd.org/Index.aspx?DataSetCode=FDI_FLOW_INDUSTRY

66 Sorensen, K., & Johnson Jorgensen, J. (2019). Millennial perceptions of fast fashion and second-hand clothing: an exploration of clothing preferences using Q methodology. Social Sciences, 8(9), 244.

67 https://www.circularonline.co.uk/news/just-21-of-2020-circularity-targets-met-by-global-fashion-brands/

R&D and new business models. Across the industry only about 1% of revenues are spent on R&D (lower than other consumables). Even if all of this is invested in sustainability, we could perhaps expect a similar proportion to that invested by Inditex to be invested in the transition to circular (10%). This gives us a global figure of $1.5 billion. Along with that invested in new business models (estimated at about $500 million globally), we get a total of $2 billion.

These investments pale in comparison to the total investment required to achieve a 'step change' in sustainability by 2030 ($20-$30 billion).[68] The needs are greatest in relation to raw material and end use of fabrics. A similar estimate has been provided by another source for the investment required to bring alternative fabrics such as hemp, fruit or nettle to scale.[69] The global eco fibre market size was valued at USD 40.58 billion in 2019 and is expected to grow at a compound annual growth rate (CAGR) of 4.6% from 2020 to 2027. However, this most likely includes fabrics such as organic cotton and linen, the use of which would also need to be limited in a circular economy model.[70] We can include the hemp fibre market (valued at $221 million in 2019) bringing the total circular fashion spend to $2.2 billion.

Electronics

As little as 17% of e-waste is recycled in formal recycling centres with adequate worker protection.[71] There are also large regional differences (as high as 54% in Western Europe and as low as 0% in Western Asia). It's also the fastest growing waste stream, and investment in recycling facilities is not catching up with the growth. Evidence suggests that this has been exacerbated by homeworking during the Covid-19 pandemic.[72] There is clear scope to improve e-waste recycling and reduce the potential harmful impacts through exposure to toxins. On the other hand, as we have seen with other consumables, corporate investments are more focused on recycling than designing products that last longer. Table 12 gives some examples of investments in e-waste recycling schemes/new circular technologies by technology and household appliance companies.

68 https://fashionforgood.com/wp-content/uploads/2020/01/FinancingTheTransformation_Report_FINAL_Digital-1.pdf

69 https://www.forbes.com/sites/isabeltogoh/2020/01/24/rental-and-resale-are-hot-heres-where-sustainable-fashion-also-needs-billions-worth-of-investment/?sh=683a3e3063ea

70 https://www.grandviewresearch.com/industry-analysis/eco-fiber-market#:~:text=The%20global%20eco%20fiber%20market,4.6%25%20from%202020%20to%202027.

71 https://www.itu.int/en/ITU-D/Environment/Pages/Spotlight/Global-Ewaste-Monitor-2020.aspx

72 https://www.recyclingtoday.com/article/study-highlights-pandemic-drives-increase-e-waste/

Table 12: Investments in circular electronics

Company	Investment	Amount (MUSD)
Apple	Partnered with companies and governments to invest a combined into the research and development of carbon-free aluminium smelting.	$144
Microsoft	Investment in Closed Loop Partners' funds to help accelerate the infrastructure, innovation and business models for supply chain digitization, e-waste collection, food waste reduction, and recycling industry products	$30
Amazon	Investment in Closed Loop infrastructure fund to minimise waste and support recycling	$10
Bosch	Investment in environmental protection in Germany	$53

In addition to these investments, companies such as Microsoft and Bosch have targets to be carbon neutral but much of this will be achieved through carbon offsets, rather than tackling issues that reduce e-waste. Moreover, companies like Apple have consistently been found to adopt counterproductive policies. For example, it has reached a deal with Amazon to remove unauthorised refurbished versions of its product from its listings, and has been investigated by several countries for deliberately building obsolescence into its products.[73] Companies such as Epson, Canon, HP and Brother have also been investigated in France for allegations that the firms deliberately shorten the life of print cartridges.

There are examples of companies where circularity appears to be more integral to their core business. For example, Shneider Electric reports that circular activities now account for 12% of its revenues (equivalent to €3.2 billion based on 2019 revenues). Phillips have also pledged to generate 25% of their income from circular activities by 2025.[74] This represents a value of €4.8 billion based on 2020 sales data.[75] Circular electronics start-ups are also appearing and attracting investment (e.g. Hyla Mobile which has raised $145.1M[76] and Close the Loop that recycles printer cartridges currently has revenues of $6 million), although these appear to be on a much smaller scale even than in textiles.

E-waste recycling is also a financially profitable activity due to the material value of spent devices and has been estimated globally at between $62.5 billion[77] and $150 billion per year.[78] In a recent House of Commons report, the Green Alliance report that UK manufacturers spend five times more on resource inputs than they do on labour and estimated that using those resources better would yield a £10 billion in additional profits to the manufacturing sector.[79] Dell has reported to have saved $2 million dollars through using recycled materials in the five years to 2019.[80]

The current e-waste management market size was valued at $41.97 billion in 2019, and is projected to reach $102.62 billion by 2027, growing at a CAGR of 11.9% from 2020 to 2027.[81] This compares with a consumer electronics market of $1.7 trillion and a household

73 https://www.bbc.com/news/world-europe-42615378

74 https://www.philips.com/a-w/about/sustainability/circular-economy.html

75 https://www.results.philips.com/

76 https://www.crunchbase.com/organization/erecycling-corps/company_financials

77 https://news.itu.int/a-new-circular-vision-for-electronics-end-ewaste/

78 https://www.ellenmacarthurfoundation.org/assets/downloads/Circular-Consumer-Electronics-FV.pdf

79 https://committees.parliament.uk/publications/3675/documents/35777/default/

80 https://about.bnef.com/blog/dell-eyes-63-billion-e-waste-recycling-opportunity-qa/

81 https://www.alliedmarketresearch.com/e-waste-management-market#:~:text=The%20e%2Dwaste%20management%20market%20size%20was%20valued%20at%20%2441.97,11.9%25%20from%202020%20to%202027.

appliance market of 306 billion.[82] The leading market players in e-waste recycling are listed in Table 13. It is interesting to note that two of the market leaders are large mining companies. This will be discussed again below in 3.5.

Table 13: E-waste recycling

Company	Financial data
Aurubis AG	The 4th largest copper mining company in world acquired Metallo a multi-metal recycling company in 2020 for €380 mn.[83]
Boliden AB	The 11th largest copper mining and the 5th largest zinc mining company in the world also operates the Rönnskär smelter - a world leader in electronics recycling – which had an operating profit of €51 million in 2019. Its Bergsöe smelter is one of Europe's largest recycling installations for lead acid batteries and lead battery recycling with an operating profit of €9 million in 2019.[84]
Electronic Recyclers International Inc.	A US-based e-waste recycling company with a turnover of €469 million.
LifeSpan Technology Recycling Inc.	A US-based e-waste recycling company with a turnover of USD37.99 million.
MBA Polymers Inc.	Plastics and e-waste recycler with revenue of £8.65 million in 2018, raised USD125 million in total funding.
SIMS Metal Management Limited	Metal recycling company that also specialises in e-waste under its Sims Lifecycle Services brand. In the second half of 2019 SLS posted an 800 percent rise in EBIT, from USD620,775 in the second half of 2019 to USD5.28 million in the second half of 2020.
Stena Metall AB	Stena Recycling international group generates USD1.03 billion in sales.
Tetronics Limited	Waste management company with a turnover of USD4 million.
Umicore SA	Global materials technology and recycling group with revenues of USD3.2 billion in 2020.

As discussed, the tension between the financial imperative to sell an increasing number of electronic products and the environmental need to slow and narrow the loop creates a difficulty for companies and regulators. A report to the UK's House of Commons committee found a need for greater investment in the sorting, recycling and treatment of electronic waste, especially to keep pace with the increasing amount being generated.[85] However, it also stressed the need for stronger regulation on right to repair, planned obsolescence and Producer Compliance Schemes as well as VAT and tax breaks to ensure targets are met.

3.2 Construction

The global construction industry is expected to reach an estimated $10.5 trillion by 2023, and it is forecast to grow at a CAGR of 4.2% from 2018 to 2023. The future of the global construction industry looks good,[86] yet, it is responsible for over 30% of the extraction of natural resources, as well as 25% of solid waste generated in the world. Circular construction has significant scope for impact therefore.[87]

82 https://www.thebusinessresearchcompany.com/report/household-appliances-market#:~:text=The%20global%20household%20appliances%20market,nearly%20%24433.4%20billion%20by%202023.

83 https://www.recyclingtoday.com/article/aurubis-acquires-metallo-group/

84 https://www.boliden.com/globalassets/about-boliden/corporate-governance/general-meetings/2020/eng/annual-and-sustainability-report-2019.pdf

85 https://cdn.ca.emap.com/wp-content/uploads/sites/6/2020/11/electronic-Waste-and-the-Circular-Economy1.pdf

86 https://www.businesswire.com/news/home/20210111005587/en/Global-Construction-Industry-Report-2021-10.5-Trillion-Growth-Opportunities-by-2023---ResearchAndMarkets.com#:~:text=The%20global%20construction%20industry%20is,non%2Dresidential%2C%20and%20infrastructure.

87 https://www.sciencedirect.com/science/article/abs/pii/S0959652620310933

For consumables, we have argued that investment is skewed towards closing, rather than narrowing or slowing the loop. However, construction is arguably an essential service where slowing and narrowing loops could be potentially socially damaging as it would lead to a smaller housing stock. However, data show that in OECD countries 65% of the projected building stock required by 2060 already exists, but 50% to 70% require energy intensity improvements.[88] Even in developing countries where a lack of adequate, affordable housing supply, is a significant problem, there are increasing calls - supported by an emerging evidence base - for the focus to be on improving the quality of existing housing rather than on new developments.[89] Substantial social and environmental economic gains could be made through focusing investment on retrofitting and refurbishment. Several studies also highlight the economic benefits, with one study suggesting that 2 million new jobs could be created in a European country of 50–70 million people from retrofitting.[90]

There is also significant potential for growth. The global energy retrofit systems market size was valued at USD 132.8 billion in 2019 and is anticipated to grow at a compounded annual growth rate (CAGR) of 4.1% from 2020 to 2027.[91] However, this is still only 1.2% of the global construction industry.

As well as the shift from new construction to refurbish/retrofit, there are also circular gains to be made from the use of alternative building materials (especially cement) and closing building loops. Sistemiq report investment opportunities of €117 billion investment by EU companies in these activities. As with consumables, the 'low hanging fruit' for construction is in waste management and closing building loops, rather than investment in new technologies. A report on the UK's Green Investment Bank, for example found that a circular fund went mainly into waste management, rather than targeting infrastructure that would help grow a circular economy.[92] On the other hand, a breakdown of the Sistemiq finds the largest opportunity in building design and business models ($105 and $10 billion respectively, rather than waste management ($2 billion)).

The global cement market is set to hit $725 billion in 2025 with a 7.3 percent compound annual growth rate between now and then.[93] The 'green' cement industry is worth less than 10% of that and was valued at $609 million in 2019. It is also set to grow at a lower CAGR of 4.3% to 2026.[94] Cement alternatives are far from mainstream therefore and although there are promising alternatives, more R&D is required. Some of the leading cement providers are investing in green cement but the amounts are still relatively small. Notable examples include:

- LafargeHolcim in partnership with an American start-up, Solidia Technologies, has developed a novel form of concrete that reduces the overall carbon footprint by up to 70%. Solidia has several investors including BP Ventures with $75 million raised in its latest funding round.

88 https://www.ellenmacarthurfoundation.org/assets/downloads/The-Built-Environment.pdf

89 Speak, S (2019) The State of Homelessness in Developing Countries [Presented to the Expert Group Meeting on 'Affordable housing and social protection systems for all to address homelessness, UN Offices, Nairobi], available at: https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2019/05/SPEAK_Suzanne_Paper.pdf

90 https://www.ellenmacarthurfoundation.org/assets/downloads/The-Built-Environment.pdf

91 https://www.grandviewresearch.com/industry-analysis/energy-retrofits-systems-market#:~:text=The%20global%20energy%20retrofit%20systems,4.1%25%20from%202020%20to%202027.

92 https://committees.parliament.uk/writtenevidence/21762/html/

93 https://investingnews.com/innspired/eco-friendly-alternatives-to-cement/

94 https://www.gminsights.com/industry-analysis/green-cement-market#:~:text=The%20global%20green%20cement%20industry,increasing%20infrastructure%20and%20construction%20activities.

- Heidelberg Cement has developed an alternative clinker technology called TernoCem. However, this has been heavily supported by EU funding with Heidelberg contributing between 2-3 million per year to the R&D.[95]
- A consortium of companies including Tarmac and Heidelberg Cement support the Low Emissions Intensity Lime and Cement project along with Heidleberg cement and others. This has received €12 million from EU Horizon funding with €9 million provided by the consortium.[96]
- CEMEX has made various investments including the development of a greener cement investing US$25 million to phase out fossil fuels at Rugby cement plant in 2021 and funding a loan facility of 3.2 billion described as the largest sustainability-linked loans in the world.[97]

Outside of cement there is also the growth of circular building companies where circularity is embedded across all phases of construction. The Giant 300 ranks the top U.S. architecture, engineering, and construction firms across 44 building sectors and specialty categories, by revenue. Analysis of the top 85 'green' construction firms shows that they have combined revenues in 2017 of about $40 billion.[98]

The final area of note in construction is recycling. Although recycling rates are improving, there is still much variation globally from 80% of materials in Germany and the Netherlands to 50% in the US.[99] The global construction waste recycling market was valued at $126 billion in 2019, and is expected to reach $149 billion by 2027, registering a CAGR of 2.7% from 2020 to 2027.[100] Aluminium also has a high ecological footprint but retains its value after demolition. Novelis, one of the largest aluminium recycling companies in the world is owned by an Indian aluminium manufacturing company - Hindalco industries - with revenues of 11 billion in 2020.

3.3 Mobility

Tracking circular investment in mobility is challenging, given how integrated mobility is with urban planning and more generic green investment such as renewable vehicles. Investments that are considered circular include walking and cycling infrastructure, compact city planning, public transport, circular car manufacturing and electric vehicles.[101] However, sustainable transport and urban planning are out of the scope for this study. Instead, we focus on mobility systems that promote sharing and renting, circular cars
and recycling.

Although much of the environmental emphasis in the automotive industry (and government supports for it) are on reducing tailpipe, rather than material emissions, electric vehicles (EVs) still require many raw materials and carbon-intensive processes such as aluminium smelting. Moreover, batteries are a new potential source of e-waste. It is estimated that by 2030, at least one-third of carbon emissions in vehicles will come

95 https://www.heidelbergcement.es/sites/default/files/assets/document/a4/d2/heidelbergcement-sustainability-report-2018.pdf
96 https://www.project-leilac.eu/latest-news
97 https://www.cemex.com/-/cemex-takes-the-lead-in-green-financing-and-successfully-extends-facilities-agreement
98 https://www.bdcnetwork.com/top-85-green-construction-firms
99 https://www.sciencedirect.com/topics/earth-and-planetary-sciences/construction-waste
100 https://www.alliedmarketresearch.com/construction-and-demolition-waste-recycling-market-A06246
101 https://www.ellenmacarthurfoundation.org/assets/downloads/1_Mobility_Planning_Mar19.pdf

from material production.[102] Several initiatives are underway to improve the circularity of transport including remanufacturing, car sharing and recycling. In 2019 the industry reportedly pledged to spend $225 billion on EVs in the coming years, including a pledge by GM and LG to spend $2.3 billion on batteries.[103] This compares with an estimated total industry value of about $2 trillion.[104] If we assume that about 2.5% of these sales come from electric vehicles, this gives us an annual value of EVs of $52 billion. The value of the global electric vehicle battery recycling market was valued at $138.6 million in 2017, and is projected to reach at $2.2 billion by 2025, growing at a CAGR of 41.8%.

Several companies are also investing heavily in remanufacturing and car sharing. The global car sharing market was valued 33.5 billion USD in 2018 and will reach 103 billion USD in 2025, with a CAGR of 17.2% during the forecast period.[105] Renault has a wholly owned subsidiary – Renault environment – as well as a plant that is dedicated entirely to remanufacturing and a car sharing unit. It is estimated that 'mobility solutions' will account for 20% of Renault revenues by 2030 (or the equivalent of €11 billion based on 2019 revenues). Daimler have recently bought Car2Go (a car-sharing service worth €280 million) and Flinc (a peer-to-peer carpooling startup), and invested $250 million in Via (a carpooling and shuttle service) and $60 million in StoreDot (a battery startup). Other leading manufacturers - General Motors, Ford, Volkswagen and Volvo – have also invested in mobility start-ups to broaden their portfolios of transport options.

A further relevant business model is Mobility as a Service (MaaS) with leading provider MaaS Global raising $53 million in 2019 from a range of investors including Toyota, BP Ventures, Mitsui Fudosan, Mitsubishi Corporation and Nordic Ninja. The MaaS industry is valued at about $74 billion[106] and forecast to grow to a revenue of approximately $500 billion by 2030. Sistemiq data report 136 billion of investment opportunities in circular transport in EU companies (100 billion in integrated mobility systems, 35 billion in remanufacturing car parts and 1 billion in designing and producing circular cars.

3.4 Food and food processing

It is useful to separate out agriculture and processing separately within the food system, as the impacts and circular solutions are quite different. We begin with food and drink.

Food and drink

The global food and beverages market is valued at around $6 trillion. The market is expected to grow at a CAGR of 7% from 2021 and reach $7.5 billion in 2023.[107] As with consumables, we again find an emphasis in spending on reducing packaging and recycling rather than in reformulations of products. Some examples of investments by the largest companies are listed in Table 14.

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102 https://www.mckinsey.com/business-functions/sustainability/our-insights/sustainability-blog/this-surprising-change-can-help-the-auto-industry-tackle-emissions-goals

103 https://www.wsj.com/articles/gm-lg-to-spend-2-3-billion-on-venture-to-make-electric-car-batteries-11575554432

104 https://www.prnewswire.com/news-releases/new-tech-could-transform-the-2-trillion-auto-industry-673561583.html#:~:text=The%20auto%20industry%20is%20worth,of%20dollars%20of%20unnecessary%20cost.

105 https://www.prnewswire.com/news-releases/global-car-sharing-market-value-will-reach-103-billion-usd-in-2025--with-a-cagr-of-17-2-during-the-forecast-period---valuates-reports-300948994.html#:~:text=Global%20Carpooling%20Market%3A,15.2%25%20during%202019%2D2025.

106 https://www.statista.com/statistics/1180559/global-mobility-as-a-service-market-size/

107 https://www.prnewswire.com/news-releases/world-food-and-beverages-market-analysis-and-forecasts-2020-2030-301160911.html#:~:text=The%20global%20food%20and%20beverages%20market%20is%20expected%20to%20grow,the%20measures%20to%20contain%20it.

Table 14: Circular investments in the food and drink industry

Company	Initiative	Amount (MUSD)
Nestlé	Sustainability fund, to support companies developing innovative packaging and recycling technologies.	$2,000
Starbucks	Develop a fully compostable, recycled cup[108]	$10
Danone	Closed Loop Fund (recycling)	$5.25
	Expand plant-based food	$12 $16.9
	Climate acceleration plan (includes regenerative agriculture, packaging and carbon reduction	$2,000
PepsiCo	Packaging and recycling	$65
	Green Bond (packaging, water and decarbonisation)	$1,000
	Water treatment technology	$9
Anheuser-Busch InBev	Sustainability Linked Loan Revolving Credit Facility (packaging, water and decarbonisation)	$10,100 (partnership with several banks)
	Closed Loop Fund	$250,000
JBS	Environmental stewardship in 2019	$127
	Investment in plant-based brand	$10.9
Coca Cola	Investment in Circulate Capital to address ocean plastic	$15
	Sustainability and transition to circular economy	$1,000
	Fruit circular economy	$1,700
Kraft Heinz group	Environmental management	$200
	'Disruptive' venture capital	$100

The descriptions of where funding is going are often quite opaque and it can be difficult to identify how circular these really are. Many of these companies have been the subject of environmental controversies for years on issues relating to deforestation, palm oil, plastic pollution and carbon emissions.[109] [110] [111] These investments often follow exposures of environmental risks and are treated with scepticism by environmental campaigners. Moreover, despite the emphasis on reducing plastic pollution, global banks have recently been accused of collectively providing more than $1.7trn to businesses across the plastics value chain between 2015 and 2019, largely without attaching environmental conditions to support packages.[112]

Unsurprisingly, less is being spent on refusing/reducing food and drink consumption. However, some companies are reformulating products to reduce portion size/calorie intake in response to obesity policies. Industry research suggests that 88% of companies had introduced products supporting healthier diets and lifestyles, and there is year on year improvement in the volume of calories being cut from food and drink products.[113]

108 http://www2.paconsulting.com/rs/526-HZE-833/images/PA%20Innovation%20for%20Sustainability%20Report.pdf
109 https://www.theguardian.com/environment/2020/jul/28/investors-drop-brazil-meat-giant-jbs
110 https://www.ran.org/press-releases/sustainability_issues_shadow_the_kraft_heinz_merger/
111 https://www.independent.co.uk/life-style/coca-cola-pollution-plastic-environment-coke-a9168921.html
112
113 https://www.rwjf.org/en/library/articles-and-news/2014/09/foodindustryleadersfindingwaystohelpsolvenationsobesityepidemic.html

These investments are positive by-products from the obesity crisis and government pressure to address this however, rather than direct circular investments.

Alternative food and drink options that are less environmentally damaging are also experiencing growth. The global vegan food market size was valued at USD 12.69 billion in 2018 and is projected to expand at a CAGR of 9.6% from 2019 to 2025.[114] Investment in veganism also continues to grow. In the US, 90% of meat companies have either bought existing plant-based food brands, launched their own, or entered into collaborations with plant-based companies, and the leading food producers all offer plant based options.[115] Plant-based start-ups are also seeing significant investment, with $535 million invested in pre-exit companies in 2018 and $73.3 million has been invested in cell-based meat companies.[116] On the other hand, these are a fraction of what is being invested in traditional food and drink. Investments in plant-based food companies, were 6.5% of those made in the general FoodTech sector and only 0.7% of those made in the AgTech industry in 2018. Investments in cell-based meat were even smaller: 0.5% of investments in FoodTech and 0.05% of AgTech investment.[117]

Agriculture

Over the past 50 years agriculture has become more resource-intensive relying heavily on fossil fuels, and fossil fuels derived from synthetic fertilisers. There are generally three elements to circular agriculture[118]:

- Production of commodities using a minimal amount of external inputs (narrowing/slowing loops)
- Reducing discharges to the environment (closing loops)
- Valorising agri-food wastes (closing loops)

Although some progress is being made on circular agriculture, this very much concentrated in Europe. A literature review of circular agriculture found that 80% of the published studies were based on European case studies (especially Italy).[119] Much of the technology required (e.g. to upcycle waste materials into more valuable products) is still in development and there are several EU-funded initiatives underway to further these.

Of the sectors we have looked at so far, agriculture is perhaps the most socially valuable, and one where narrowing/slowing the loop is more challenging in a world where 10% of the population experience under-nourishment.[120] Indeed, more food will be required to ensure food security into the future, and it is generally accepted that food production systems will need to change to achieve this.[121] Some argue that the current production is sufficient to meet population growth if radical changes to dietary choices, such as more plant-based diets and converting more of existing foodstuffs for direct human consumption.[122] In practice, a combination of the two are likely to be desirable as the current system of food production is a major contributor to environmental harm.

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114 https://www.google.com/search?q=value+of+vegan+market&rlz=1C1CHBF_enIE892IE892&oq=value+of+vegan+market&aqs=chrome..69i57j0j0i390l4.44877j1j4&sourceid=chrome&ie=UTF-8

115 https://faunalytics.org/follow-the-money-part-1-current-trends-in-plant-based-investment/

116 https://faunalytics.org/follow-the-money-part-1-current-trends-in-plant-based-investment/

117 https://faunalytics.org/follow-the-money-part-1-current-trends-in-plant-based-investment/

118 https://www.sciencedirect.com/science/article/pii/S1876610217328436

119

120 https://www.worldhunger.org/world-hunger-and-poverty-facts-and-statistics/#:~:text=The%20United%20Nations%20Food%20and,from%20chronic%20undernourishment%20in%202016.

121 https://www.wri.org/blog/2018/12/how-sustainably-feed-10-billion-people-2050-21-charts

122 https://online.ucpress.edu/elementa/article/doi/10.1525/elementa.310/112838/Current-global-food-production-is-sufficient-to

According to the World Bank, 28% of the world's economically active population (1 billion people) are employed in agriculture, and this is as high as 70% in some low-income countries.[123] Agricultural employment is also concentrated within low-income groups and is also essential to livelihoods. Globally, it is also highly valuable with an estimated value of $8 trillion.[124]

The value of more sustainable farming methods are more challenging to estimate than in other sectors as agriculture is undergoing something of a transition, and identifying what counts as circular spending outside of R&D is challenging. The indoor farming market is one which achieves higher yields and includes techniques like precision-farming. This market is estimated at USD 14.5 billion in 2020; it is projected to grow at a CAGR of 9.4% to reach USD 24.8 billion by 2026.[125] This is currently 0.1% of the agrifood sector.

The second major area of development is agri-food waste. In 2019, agri-food waste reached approximately 1.3 billion tonnes (one third of all food produced) with an annual cost of more than $1trillion per year. The FAO also estimates that in addition to this, environmental costs of food waste reach around USD 700 billion and social costs around USD 900 billion through impacts on emissions, biodiversity, livelihoods and so on.[126] Identifying current spending on agri waste recycling has not been possible, however, the global food waste management market size was estimated at USD 34.22 billion in 2019. It is expected to expand at a compound annual growth rate (CAGR) of 5.4% from 2020 to 2027.[127]

Another major source of emissions is animal feedstuffs. This market is projected to grow at a CAGR of 4.90% to reach US$460.322 billion by 2026, from US$345.434 billion in 2020. However, the market for more sustainable feeds is growing faster. The global insect feed market was valued at USD 687.8 million in 2018 and is projected to reach a value of USD 1,396.4 million by 2024, registering a CAGR of 12% during the forecast period.[128]

It is interesting to note that of these approaches, Systemiq identify more investment opportunities in in indoor farming ($45 billion) relative to other methods such as deploying regenerative agricultural practices ($15 billion), closing nutrient loops ($10 billion) and innovative feeds ($2 billion).

3.4 Mining and extractives

The main method by which mining companies are operating in the circular economy is through e-waste recycling, and we have already discussed Boliden and Aurubus in this context. Oil and gas companies like Shell and BP are also investing in a range of companies across the circular economy including mobility solutions and green cement.

Circular mining is supported by an EU-funded project called ProSUM - Prospecting Secondary Raw Materials in the Urban Mine and Mining Wastes – which is designed to enable commercial companies to track the materials available for mining from scrap vehicles, dead batteries and waste electronic and electrical equipment. There are a few

123 http://blog.resourcewatch.org/2019/05/30/map-of-the-month-how-many-people-work-in-agriculture/#:~:text=Globally%2C%20about%201%20billion%20people,the%20population%20employed%20in%202018.

124 https://techcrunch.com/2018/11/01/agrifood-the-8trn-industry-thats-worth-your-salt/

125 https://www.globenewswire.com/news-release/2021/02/25/2182175/0/en/The-indoor-farming-technology-market-is-estimated-at-USD-14-5-billion-in-2020-and-is-projected-to-grow-at-a-CAGR-of-9-4-to-reach-USD-24-8-billion-by-2026.html

126 http://www.fao.org/3/i3991e/i3991e.pdf

127 https://www.grandviewresearch.com/industry-analysis/food-waste-management-market

128 https://www.globenewswire.com/news-release/2020/03/09/1996978/0/en/Global-1-39-Bn-Insect-Feed-Market-2024-Insights-Into-Growth-Trends-Opportunities.html#:~:text=The%20global%20insect%20feed%20market,12%25%20during%20the%20forecast%20period.

other notable companies. Mitsubishi Materials have partnered with the EMF and adopted circular economy principles in their literature. They are also expanding their recycling capacity, including a recent purchase of a Swiss plastic recycling group - Minger - which has a turnover of €9.3 million.[129] They also invested €30.8m in an e-waste manufacturing plant in the Netherlands which derives about 14% of its income from recycling.[130] JX Nippon Mining & Metals another Japanese company have funded a research position on the circular economy at Osaka University. According to their annual report they generate 6.1 billion JPY (€47 million) from recycling and environmental services. This is out of a total turnover of 68 billion (5.2 billion), or 8%.

A second area where there is some investment is waste to energy/chemicals (WTE/WTC). For example, a €200 million W2C project in the Netherlands has been described as the world's biggest circular manufacturing plant and is funded by a consortium that includes oil and gas, chemical companies and recycling companies.

The big investors in W2E include recycling companies (Hitachi Zosen Inova AG), steel manufacturers (Chonqing Iron and Steel Company) and mining companies (China Metallurgical Group). The global value of the waste-to-energy market reached 35.1 billion U.S. dollars in 2019. By 2027, the waste-to-energy market is expected to be valued at 50.1 billion U.S. dollars, growing at a CAGR of 4.6 percent from 2020 to 2027.[131]

Finally, there is carbon capture and storage. The IEA identifies 16 big projects around the world representing $27 billion of investment which are at the advanced planning stage, and which could double carbon storage capacity to around 80 million tonnes. Oil and gas are one of the big investors. In 2016 the Oil and Gas Climate Initiative (OGCI), representing companies that make up 32% of the industry announced an investment of $1 billion to 2016, to develop and accelerate the commercial deployment of these technologies. Exxon Mobil has recently announced a $3 billion investment over the next 5 years in new CCS projects.[132] The CCS market is estimated to be worth $10.45 Billion by 2026 at a CAGR of 11.5%. The oil and gas industry was worth $3.3 trillion in 2019.

3.5 Start-ups

The data for this section is drawn from the I3 research database, which is built from profiles on over 30,000 companies and 10,000 investors globally.

The analysis finds 2493 companies related to waste and recycling with investments of 2.3 billion in 2020 up from just over a billion in 2019. There was a sharp drop in the volume of investments in from the second quarter of 2020, presumably due to Covid-19. There were 1017 recycling companies. These saw a decline in funding between 2018 and 2019, which revived again in the first quarter of 2020 before falling again. There were 103 companies related to the circular economy. These companies had investments of almost 500 million in 2019, up from 70 million in 2018. However, there was also a fall in investments in 2020 to around 200 million. Bioplastics (n=141) also saw strong growth in funding in 2020 up to 450 million from 100 million in 2019.

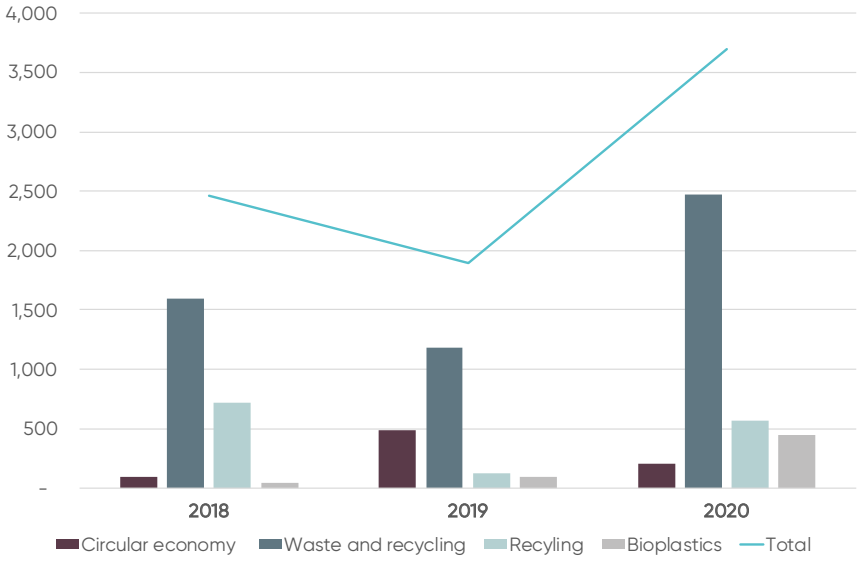
129 https://www.plasteurope.com/news/MITSUBISHI_CHEMICAL_t244637/

130 https://www.mmc.co.jp/corporate/en/ir/pdf/kessan2021-3e.pdf

131 https://www.statista.com/statistics/480452/market-value-of-waste-to-energy-globally-projection/

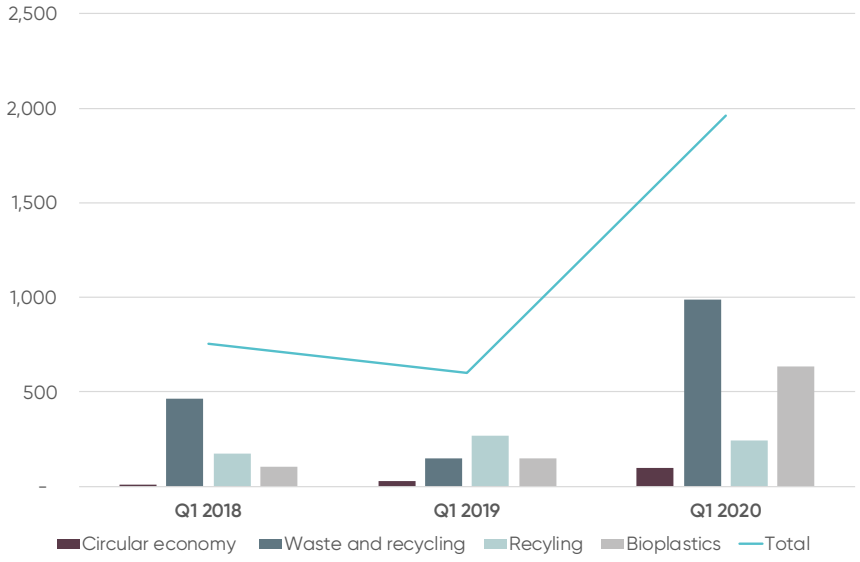
132 https://www.forbes.com/sites/daneberhart/2021/03/09/oil-giants-bet-big-on-expected-2-trillion-carbon-capture-market/?sh=1d183083e8a4

Figure 6: Investment in circular economy-related start-ups (2018-2020)



Despite the pandemic, we can see overall growth in these sectors, especially in bioplastics and waste, and compared with the years prior to 2017 (Figure 4). This trend is stronger when we remove quarters 2-4 in 2020 (i.e. to account for pandemic impacts (Figure 5).

Figure 7: Investment in circular start-ups (Q1, 2018-2020)



We can add these investments to those outlined above to get an indication of the size of global start-up circular market (Table 15). Although only based on a sample of companies, the total of $4.35 billion amounts to just 2.5% of global venture capital investment of $171 billion in 2017.

Table 15: CE start-ups in key sectors

Sector	Market size (MUSD)
Fashion	$500
Plant-based start-ups	$535
Cell-based meat	$73
Bioplastics	$450
Waste and recycling	$2,300
Circular companies	$500
Total	**$4,350**

3.6 Conclusion

In this section, we have identified the main components of the circular economy in each of the main relevant markets and have sought to value each of these components. As we can see in Table 16 below, while significant and growing in some areas, spending on the circular economy is a small percentage (in low single digits) of linear economy investment.

There are several caveats to this. We have significant data gaps, especially for R&D spending. R&D has only been included for a few of the sectors and these are estimates. On the other hand, for many of the sectors, R&D spending is small (in single digits), so this is unlikely to be a gross underestimation. However, for some sectors such as agriculture and automotive there are likely to be larger gaps. For the automotive industry for example, we do not know how much companies are investing the development of circular cars. The valuations are generally taken from market analysis or trade magazines. Virtually nothing is known about the methodologies for reaching the valuations and their robustness cannot be verified.

Precision is generally elusive in deriving these estimates. It is impossible to identify whether an area of spending is fully circular or not. For example, eco-fibres may be produced from organic cotton that would not meet the standards of circular agriculture. Moreover, some agricultural practices (e.g. in small scale farming) may count as circular but there is no data on this. Finally, there will be overlaps between the sectors (cotton and agriculture being one example) and there is a risk of double counting.

As a result of these caveats, the figures should be treated as the start of a conversation produced for illustrative purposes rather than a definitive list.

Table 16: Circular Market (CM) vs. Linear Market (LM) estimates

Sector	LM value (BUSD)	CM component	CM value	Proportion
Fashion	$1,500	Resale	$7 billion	5%
		Rental	$1.26 billion	
		Artisinal	$34 billion	
		R&D/new business models	$2 billion (estimate)	
		Hemp	$0.2 billion	
Electronics	$2,000	E-waste market	$42 billion	2%
Construction	$10,500	Retrofit market	$132.8 billion	3%
		Green cement	$609 million	
		Green construction	$40 billion	
		Recycling	$126 billion	
Mobility	$2,000	Electric vehicles	$52 billion (estimate)	6%
		Battery recycling	$1 billion (estimate)	
		Mobility as a Service	$74 billion	
Food and beverage market	$6,000	Vegan food market	$12.69 billion	2%
		Cell-based meat	$15 million	
		R&D	$128 billion (estimate)	
Agriculture	$8,000	Indoor farming	$14 billion	0.05%
		Food waste	$34 billion	
		Insect feed	$687 million	
Non-specific waste	$1,358 (less e-waste, food and construction waste and Government expenditure)	Bioplastics	$4.6 billion	8%
		Plastic recycling	$27 billion	
		Unaccounted for recycling	$79 billion	
Mining and extractives	$3,600 (mining and oil and gas)	Waste to energy	$35 billion	
		Waste to chemicals	N/A	
		E-waste	Already counted	
		CCS	$10.45 billion	
Total	$35,400		$800 billion	3%

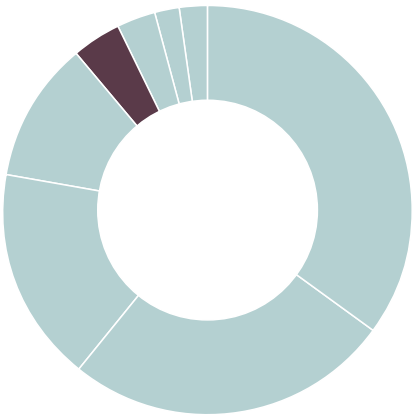
4. Finance

This section has three parts. First, we look at private financial institutions and the circular economy. The second part reviews practice in development finance institutions (DFIs) and development banks. While these could have been included in the government or ODA section (and at least some of the recorded ODA will be delivered through these institutions) it makes sense to combine these with private finance in our view. A core part of DFI's role is to mobilise private investment. As a result, they have valuable insights into the drivers of private investor decision-making, including what could be done to enhance the attractiveness of CE investments. The third section will combine information gathered as part of this paper with a targeted set of interviews with DFIs to distil some lessons on how CE investment could be increased.

4.1 Private financial institutions

Table 8 sets out the funds that are investing in the circular economy by instrument and sector (~$15 billion in total). Many of the funds are parts of larger green/ environmental/ sustainability funds and adjustments have been made to the value to take account of these – i.e. we have estimated the proportion of their portfolios that are circular economy related. In addition to these, we know that about 4% of generic green bonds are invested in waste (see Figure 7). [133]

Figure 8: Composition of green bond market



35% Energy
26% Buildings
17% Transport
11% Water
4% Waste
3% Land use
2% Adaption
2% Other

Source: UBS

Given that the green bond market is worth $700 billion annually, this would suggest that a total of $24.5 billion invested in waste via these instruments. Although an underestimation of the full value of circular elements within the market, it is a reasonable proxy. Based on this, we can estimate that the total value of circular investments is therefore somewhere in the order of $45.5 billion.[134] A breakdown of the kinds of investments by instrument and value is provided in Table 17 for a selection of financial institutions.

133 UBS (2020) Future of waste Finding opportunities in waste reduction https://www.ubs.com/global/en/wealth-management/chief-investment-office/investment-opportunities/investing-in-the-future/future-of-waste/2020/future-of-waste-part1.html

134 There will certainly be many funds that are not captured here, particularly in the more specialist VC space. These are likely to be relatively small, however.

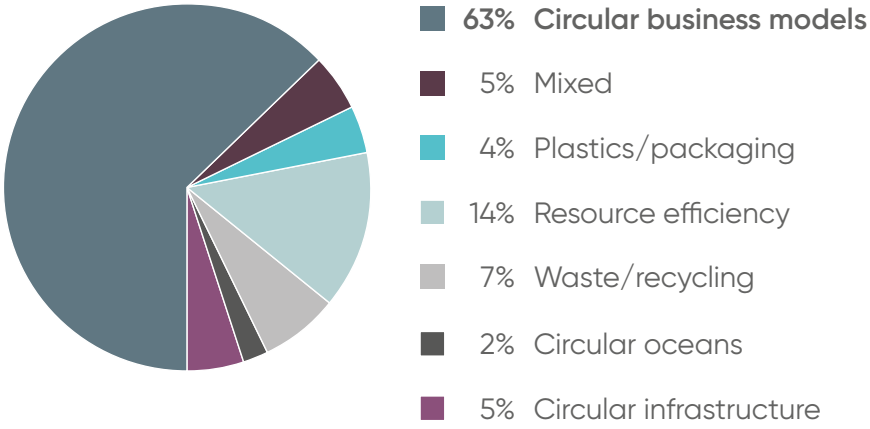
Table 17: Selection of CE investments by type and value

Investor	Sector	Instrument	Adjusted value (€ million)
Intesa Sanpaolo	Circular business models	Debt; guarantees	6,000.00
BlackRock	Mixed	Public equities	1,700.00
Archipelago Eco Investors	Plastics/packaging	Private equity	1,500.00
Lloyds Bank	Mixed	Investor commitments	1,484.74
Credit Suisse Rockefeller	Circular oceans	Public equities	1,276.91
ABN AMRO	Mixed	Debt; guarantees	1,000.00
Ambienta	Resource efficiency	Private equity	668.84
Spring Lane Capital	Waste/recycling	Project finance	578.82
Danish Green Investment Fund	Mixed	Debt	442.59
Goldman Sachs	Waste/recycling	Green bonds	427.10
Circulate Capital	Plastics	Venture capital	306.95
NN Investment Partners	Mixed	Public equities	186.33
Allianz Clean Planet Fund	Mixed	Public equities	179.66
Ultra Capital	Waste/recycling	Equities; debt	175.40
Goldman Sachs	Plastics/packaging	Green bonds	162.25
Decalia	Mixed	Public equities	146.34
BNP Paribas	Circular business models	Public equities	139.11
Anima Investimento	Mixed	Mutual fund	123.00
Candriam	Circular business models	Public equities	101.60
Circularity Capital	Circular business models	Private equity	100.00
H&M CO: LAB	Sustainable fashion	Equity (Venture capital)	100.00
Closed Loop Partners	Mixed	Mixed debt/equity	87.70
RobecoSAM	Mixed	Public equities	84.64
Tin Shed Ventures	Innovative, circular economy start ups	Equity (Venture capital)	75.00
Breakthrough Energy Ventures	Circular business models	Venture capital	69.28
Tesi	Circular business models	Private equity	68.41
Taaleri	Mixed	Private equity	65.00
Prelude Ventures	Circular business models	Venture capital	55.00
Goldman Sachs	Mixed	Public equities	50.78
The Westly Group	Tech and artificial intelligence; some circular economy	Equity (Venture capital)	50.00
Generate Capital	Circular infrastructure	Project finance	46.48
Althelia Sustainable Ocean Fund	Plastics	Equity	44.00
Tesi	Plastics/packaging	Private equity	40.00
Pangaea Ventures	Advanced materials	Equity (Venture capital)	35.00
Circular Capital	Waste/recycling	Debt; guarantees	30.70
Sky Ocean Ventures	Plastics	Venture capital	30.00
Prelude Ventures	Env/circular business	Equity (Venture capital)	20.00
Alante Capital	Circular economy textiles	Equity (Venture capital)	15.00

Source: Lawlor and Spratt (2021), Circular investment.

Classifying these investments by category is challenging as limited detail is provided on many of the investments. Nonetheless, we present a general categorisation based on best available data in Figure 6.

Figure 9: Investments by sector



As we can see, circular business models are the largest in value. These generally refer to either investments in companies that want to transition to more circular activities, or more commonly, create new circular technologies or products. It is interesting that plastics/ packaging, which are so dominant in corporate/ government investments make up a small part of financial sector investment. One reason is likely to be that much of this investment needs to be made by large, incumbent firms with respect to their own packaging – hence the high level of corporate investment. It may also be that there is little scope to break into this type of activity in a profitable way, given the presence of large incumbent firms. Finally, as with the other areas identified, it may be that 'circular business models' are being applied to these issues.

Returning to Figure 1 (reproduced below), provides a useful way of analysing the financial sector. As discussed in the introduction, our analysis suggests that most corporate investment is in the top half of the quadrant, where large firms with linear core business and linear ancillary activities seek to increase the circularity of the latter (i.e. the manufacturer of a linear product (that is non-recyclable and resource intensive) investing in recyclable or biodegradable packaging but leaving the core product unchanged). This is moving from the top left to the top right quadrant.

Most financial vehicles, in contrast, are focused on the bottom half of the quadrant, seeing long-term competitive advantages in firms with innovative, circular core business and ancillary activities, or those seeking to move that way – i.e. to ensure that non-core business is also circular. This is particularly the case with VC and early-stage private equity funds, that are looking to invest in firms that can challenge the status quo by doing this differently. Not all investment is of this kind, however. Intesa Sanpaolo have a €6bn credit line dedicated to the circular economy in Italy. Most of the funds allocated to date have been to SMEs with innovative circular economy approaches (i.e. bottom quadrant), but the bank has also partnered with larger firms seeking to innovate such as Pirelli. An unusual aspect of the Intesa Sanpaolo approach is that they see circular economy approaches as positive from a risk standpoint and offer qualifying borrowers favourable terms to reflect this lower risk profile. While Intesa Sanpaolo cannot yet prove this quantitively, they believe this is just a matter of time, and stress the importance of seeing circular economy approaches as a core strategic approach, rather than an environmental 'add-on'.

The Credit Suisse/Rockefeller Ocean Engagement Fund highlights another approach.

This fund is committed to shareholder activism with larger firms to persuade them to become more circular – e.g. move from the top left to the top right quadrant by eliminating plastic packaging.

An intermediate type of investor is the Development Finance Institution (DFI), which operates between the public and the private. DFIs have a mandate to attract private investment, and a strong environmental focus in most cases. They are therefore well placed to understand the determinants of private sector investment, including in the circular economy. The next section explores these issues.

4.2 DFI investment in the circular economy

DFIs have grown substantially in the last 10-20 years. European bilateral DFIs – i.e. those representing individual European countries – saw their combined portfolio expand by 10% between 2018 to 2019, reaching €46 bn.[135] In the US, the International Development Finance Corporation (IDFC) was created in 2019 from the merger of two entities, and can provide debt and equity financing up to a limit of US$60 bn. For many national donors, DFIs offer an efficient use of funds given their ability to mobilise private capital and are seen as key actors in the effort to close the SDG funding gap.

As well as bilateral DFIs, the International Finance Corporation (IFC) is the largest multilateral DFI, and by far the largest DFI of any kind. In 2020 alone, the IFC invested around US$10 bn., and claims to have mobilised the same level of private investment – e.g. through its syndicated loan programme (B-loan), or through the equity funds it managed (Asset Management Company [AMC]).

As well as DFIs, multilateral development banks (MDBs) such as the World Bank and regional development banks, also provide development finance. An important distinction – which does not hold in all cases – is that DFIs tend to provide equity and seek to do so on commercial terms. MDBs are more likely to provide loans, including on a concessional basis (e.g. through the World Bank's soft lending 'window').

The European Investment Bank (EIB) sits somewhere between these two. The EIB sees itself as a bank, and like DFIs therefore provides finance on commercial terms – i.e. commensurate with risk. The EIB also partners with various EU bodies, however, to provide blended products that mix its investment with concessional funds and grants from elsewhere. To highlight the blurring of the boundaries described here, several prominent DFIs also have access to concessional funds and are actively engaged in blending where appropriate. As well as its own balance sheet (A-portfolio), for example, the Dutch DFI. FMO, managed government funds which can be invested on concessional terms, and co-invested/blended with FMO's A portfolio funds.

It is beyond the scope of this paper to review DFI approaches to the circular economy comprehensively. Instead, we provide three short studies based upon interviews with representatives from prominent DFIs from countries with significant commitment to the circular economy. These are CDC (UK), DEG (Germany), and FMO (the Netherlands).

In each case, information was sought on a) how they define the circular economy, b) where they see the most/least investment opportunities, and c) what can be done to increase the quantity of investable projects.

135 https://www.edfi.eu/members/facts-figures/

CDC

In terms of definitions, CDC broadly follow the Ellen Macarthur Foundation's 'butterfly approach' but see the forthcoming EU Taxonomy as key in establishing table definitions that the sector can coalesce around. CDC's circular economy investments are organized within their climate unit, and they see merit in avoiding separating CE investments from other climate or environmental activities.

Rather than a top-down strategic approach where CDC sought to identify priority CE investment areas, the approach has been bottom-up, originating from an interest in waste projects and expanding from there. For CDC, most CE opportunities are currently in the waste sector.

CDC see CE investments in one of two buckets: start-ups seeking to implement innovative circular approaches (pure play circular); and incumbent firms in the linear economy seeking to become more circular in their operations. Broadly, there are more opportunities for CDC in the latter, not least as the ticket size for the first category is generally below the threshold where CDC operates. A solution to this would be to use CDC's Venture Scale-up Programme, but there have not been suitable CE opportunities to date. The alternative approach, which is how CDC tend to access smaller investments, would be through private equity (PE), or VC funds. A problem is that CDC's mandate (following a strategic shift in 2012) restricts their investments to Africa and South Asia, but most CE funds have a broader geographical remit than this. For example, there are reportedly three circular economy dedicated VC funds that CDC might consider investing in, but all are either global or global emerging markets in their focus.

While most CE opportunities to date have been in waste, it is difficult to obtain attractive returns in this sector, with the low cost of linear alternatives (e.g. plastic) being a major problem. For CDC, there may be better returns in other CE sectors such as remanufacturing, reverse logistics and B2B.

DEG

For DEG, the circular economy is very attractive due to its high potential impacts in a world of finite resources – i.e. it enables sustainable economic development and growth within environmental resource constraints. While the development case for CE is strong, this has not been reflected in DEG's commitments to date, due to a lack of attractive opportunities.

Like CDC, DEG also distinguish between smaller, start-ups and investments with larger established players. Small ticket size, and risk relative to transaction costs, prevents them from investing in the former using their balance sheet. There is potential to do so using existing upscaling vehicles, or technical assistance or blended finance mechanisms, but these have been focused on EU companies to date, though this has recently changed.

While DEG see the CE as much more than recycling and waste, this is where the main opportunities have arisen. The key problem is that investments have not produced the level of returns expected. For DEG there are several reasons for this. First, the profitability of recycling projects is strongly influenced by when sorting takes place, and by whom. If a recycling company receives a large quantity of undifferentiated waste for recycling, it is very labour intensive and expensive to sort this out. This is even true if the waste is just plastics, where sorting through perhaps 50 forms of plastic to isolate the types that

can be recycled can eliminate profit margin. The problem is difficult to resolve as waste collection in developing countries tends to be operated by government, and they would need to create incentives or mechanisms to promote or enforce the sorting of recycling.

Second, it is often cheaper to produce a new product than one from recycled inputs. For example, DEG was supporting a plastics recycling firm where bottles were collected at low cost, including from rubbish dumps. Despite essentially free inputs, a fall in the oil price still made it cheaper to produce and sell new plastics than could be achieved through the recycling process. As a result, the firm went bankrupt. The fact that externalities are not reflected in pricing is perhaps the most important obstacle of all in supporting a transition to a circular economy.

Third, for DEG many of the promoters attracted to recycling and waste projects lack the skills and experience needed to succeed. This seems a more prevalent problem than in other sectors, for reasons they are not entirely clear about. For this reason, as well as the issues of scale and risk discussed above, DEG are only interested in projects with experienced promoters with a relevant track record. This reinforces their tendency to work with incumbent firms in the linear economy who are seeking to become more circular in their operations.

The most important investment criterion for DEG is not therefore the part of the circular economy, but rather the identity of the promoter. As well as having the skills and experience, key to this is the ability to handle rapid growth, should this happen, while retaining a focus on the core business.

FMO

As well as the central objective of promoting private sector development in lower-income countries, FMO have a strong focus on environmental issues, and on reducing inequalities of different forms. A few years ago, FMO introduced a framework to incentivize staff to target projects that are compatible with these goals. Specifically, potential projects can be awarded a label as a green or reducing inequalities project, or both. FMO staff are incentivized to do this through targets where a certain proportion of projects each year need to be awarded labels.

Green label projects fall into one of three categories: 'mitigation', 'adaptation', and 'other footprint'. Mitigation projects cover renewable energy, heat production, energy efficiency, agriculture, forestry and land use, non-energy greenhouse gas, wastewater, waste, transport, and low carbon technologies. Adaptation projects are less defined, focusing on reducing climate vulnerability, while 'other footprint' criteria address biodiversity, pollution, or the conservation of natural resources.

The last of these contains two criteria that are specific to the circular economy:

- Recycling /solid waste collection and treatment as the core business of the project
- Company's core business is the remanufacture of products (or extend their lifecycle in other ways), servitisation or complete circular economy business models

While these criteria have been in place for some time, no projects have yet been allocated to them by FMO. While this suggests that are not engaged in circular economy investments, this depends on how this is defined. The current definition is very narrow and focused on either recycling or one 'pure play' circular economy investments. While

there are opportunities in recycling as we have seen, these are not necessarily attractive to DFIs. The second criterion is concerned with more innovative, circular economy firms where it is difficult for DFIs to find investments of sufficient size and risk profile.

A broader definition would see some projects with green labels on mitigation criteria also being seen as circular economy. For example, one of the criteria under the waste heading is: "Waste-recycling projects that recover or reuse materials and waste as inputs into new products or as a resource (only if net emission reductions can be demonstrated)." While the emissions reductions condition makes this relevant for mitigation, it is also clearly positive from a circular economy perspective. A broader definition would also make some aspects of energy efficiency relevant.

The importance of definitions was highlighted by an exercise where FMO assessed their portfolio against broader circular economy definitions used in the Netherlands. Table 18 below gives sector examples of activities that would be considered circular using a broader approach.

Table 18: Circular investments by sector using broader CE definition

Sector	Circular activity
Agri, transport, mining etc.	leasing companies
Agri	Investments identified as contributing actively to food waste reduction (Agtech and Warehousing)
Waste management	Recycling companies (dedicated to collect, process and recycle waste)
Agri	Drip irrigation system providers and agri companies that apply drip irrigation
Agri	Bagasse fuelled electricity by sugar cane production facility
Agri	Use agricultural residues to extract specific materials or chemicals, e.g. protein, use agricultural residues for (the production of) animal feed or to produce materials, e.g. for construction.
Construction	Reduce the amount of virgin materials used in construction, by using construction materials made with less raw material.
Agri	Regenerative agricultural practices (conservation tillage, cover crops, crop rotation, composting, mobile animal shelters and pasture cropping) can increase yields, quality of produce and of topsoil.

When assessed on this basis the share of FMO's portfolio that could be considered circular rose from zero to around €500 million out of a total portfolio of a little over €8 billion. Under the existing definition, about a third of FMO's portfolio has been allocated a green label, but none on a circular economy basis.

FMO plan to revisit their approach to the circular economy over the next year, and expect the definitions/criteria to change, and the area to become more prominent in their investments.

4.3 How can private investment to the circular economy be increased?

As described above, current DFI investment in the circular economy is limited, despite strong appetite to make these investments. The problems are a lack of projects that will generate sufficient returns and are of a sufficient size. These are exactly the same barriers that private investors face, which is unsurprising as DFIs seek to invest on commercial terms.

To increase the attractiveness of CE investment to the private sector, DFIs such as CDC have an important role to play by demonstrating that profitable investments can be made. For CDC, blended finance has an important role to play in this regard, where risk-adjusted returns for private investors can be enhanced to support investment before more permanent, structural changes can be achieved.

Key to this is Extended Producer Responsibility. Legislation is either already implemented or pending in many emerging economies including India, South Africa and Nigeria on this issue, but a more concerted and intensive effort – including from the MDBs – is need to push this agenda further.

In the longer term, seeing CE as a strategic business opportunity is likely to become increasingly the norm, particularly if supporting regulation and pricing can be put in place. The more that the circular economy can be linked with climate indicators and targets, the more likely this is. This is crucial, as the circular economy is at the heart of the non-energy decarbonisation agenda. Finally, the human development aspects of the CE need to be emphasized more, particularly its ability to generate employment, and employment of the kind that is inherently resistant to the automation of industry.

DEG identify a few ways that the pipeline of attractive deals, and therefore public and private investment, could be increased. First, start-ups need government support or guarantees to mitigate risk and spur innovation. Second, policy needs to be supportive of the circular economy. The case above about the importance of recycling is a good example, as is the need for Extended Producer Responsibility legislation. In Sri Lanka, DEG is supporting a successful waste to energy project, the success of which is based on the availability of a premium energy price from government.

Third, while governments need to be persuaded of the merits of these types of measures - ideally as part of an integrated circular industrial policy - this could be encouraged by policy-based lending from the major development banks. It could also be supported by advisory services from donor agencies and public or private research and development institutions. Third, DFIs, MDBs and other development actors need to demonstrate success where possible and help the companies they invest in to use resources more efficiently, as well as procure materials that are more recyclable. The housing sector is a good example, where DFIs could help companies source recyclable materials, particularly where there are government schemes to compensate for any additional costs created.

It seems clear that, for the foreseeable future, there will need to be concessional support (e.g. from blended finance) to improve the risk-return characteristics of many circular economy investments. Over the longer-term, however, the goal must be to design regulatory and fiscal frameworks such that this is not needed. The question of attracting finance will then become irrelevant, as investor do not need to be persuaded to invest in the profitable, low-risk ventures of the future.

5. Conclusions

The overall aim of this paper is to measure the size of the circular economy with a view to identifying how investment could be increased over time. We conclude by summarising the main findings and set out a series of recommendations drawing on these data and the interview material gathered as part of the research.

5.1 Summary of findings

Despite data limitations, we were able to arrive at tentative estimates for the size of circular spending on each sector. These are summarised in Table 19.

Table 19: Summary of global spending by sector in 2019/20

Sector	Circular economy estimate ($ billion)
Government	636
Government (less stimulus)	510
Corporate	800
Finance	46
Total	**1,482**
Total (less stimulus)	**1,356**

Although it is not meaningful to compare with linear economy spending in every sector, we can usefully put this into context. Global government spending in 2019 was about USD12 trillion, suggesting that 4% of government spending is circular (5% when stimulus spending is included based on an annual estimate). The value of the corporate sectors included in Table 1 is about USD35 trillion annually, suggesting that the circular proportion of this is about 3% annually. The financial sector is more difficult to compare, as annual investments is not a meaningful metric. However, to put our circular estimate in context, the total value of financial assets managed by the 500 largest asset managers alone was more than USD100 trillion in 2019.

5.2 Recommendations

Our recommendations centre around our three stakeholder groups, each of which has a role to play in transitioning to a circular economy.

For governments

Governments have strong incentives to facilitate a circular transition due to the rising costs of climate change, waste management and resource depletion. They are also uniquely placed to do so through their influence on economic incentives and regulatory structures. Specifically, we recommend:

1. Regulatory changes that operate across the value chain. At the design stage, these include right to repair, banning planned obsolescence, recyclability, and standardisation. At the waste end, this includes measures like Extended Producer Responsibility with the purpose to generate additional financial resources and stimulate sustainable product design. These measures either already exist or are in the planning process in many countries. However, they require acceleration, scaling up and tightening to ensure that companies and consumers respond in kind.
2. Governments can create powerful incentives for businesses, investors, and consumers. Environmental Fiscal Reform (EFR) for example, is the process of aligning taxes and other instruments with environmental damage (in this case non-essential linear activities), coupled with socially productive ways of raising revenue. From a CE perspective, this would begin with removing subsidies from extractive industries and increasing taxes on linear activities, freeing up resources to reduce taxes/create subsidies for circular activities. A key benefit of EFR is that taxes are designed to

maximise job creation and other socially valuable outcomes, thereby creating a 'double dividend'.

3. Finally, the most neglected part in current spending and investments are the refuse/reduce elements of the CE for which there is no private benefit. It is appropriate for governments and other institutions to consider the public benefit of activities to achieve goals in this area and to put the necessary measures in place to achieve them.

For businesses

Our central critique of CE investments by businesses is the emphasis on ancillary over core activities. There is a need for businesses to embrace the CE in a more meaningful way, rather than as a part of their marketing strategy. Specifically:

1. Audit ecological footprints of their core business and develop strategies to increase the circularity of those activities over the short-medium term.
2. Take a long-term view of risk/return by recognising the inherent risks in linear business models and bring these costs on to their balance sheets. Investors are also starting to recognise this: one bank we interviewed offers borrowers more favourable terms to reflect the lower risk profile from CE activities.

For investors

Environmental and regulatory pressures are sure to increase, and investors can get ahead of these changes by divesting their most environmentally damaging holdings. In the long run, seeing CE as a strategic business opportunity is likely to become the norm, particularly if supporting regulation and pricing can be achieved. For the foreseeable future, however, there will need to be for concessional support (e.g. from blended finance) to improve the risk-return characteristics of many circular economy investments. Where circular economy investments can already be made profitably, institutions such as DFIs have an important role to play in demonstrating this, and mobilising private investment. Given the increasing climate focus of DFIs and MDBs, the importance of the circular economy for the non-energy decarbonization agenda and the Sustainable Development Goals should be more established. Finally, the non-environmental benefits of the CE could be emphasized more, particularly its ability to generate jobs of the kind that are resistant to the automation of industry.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