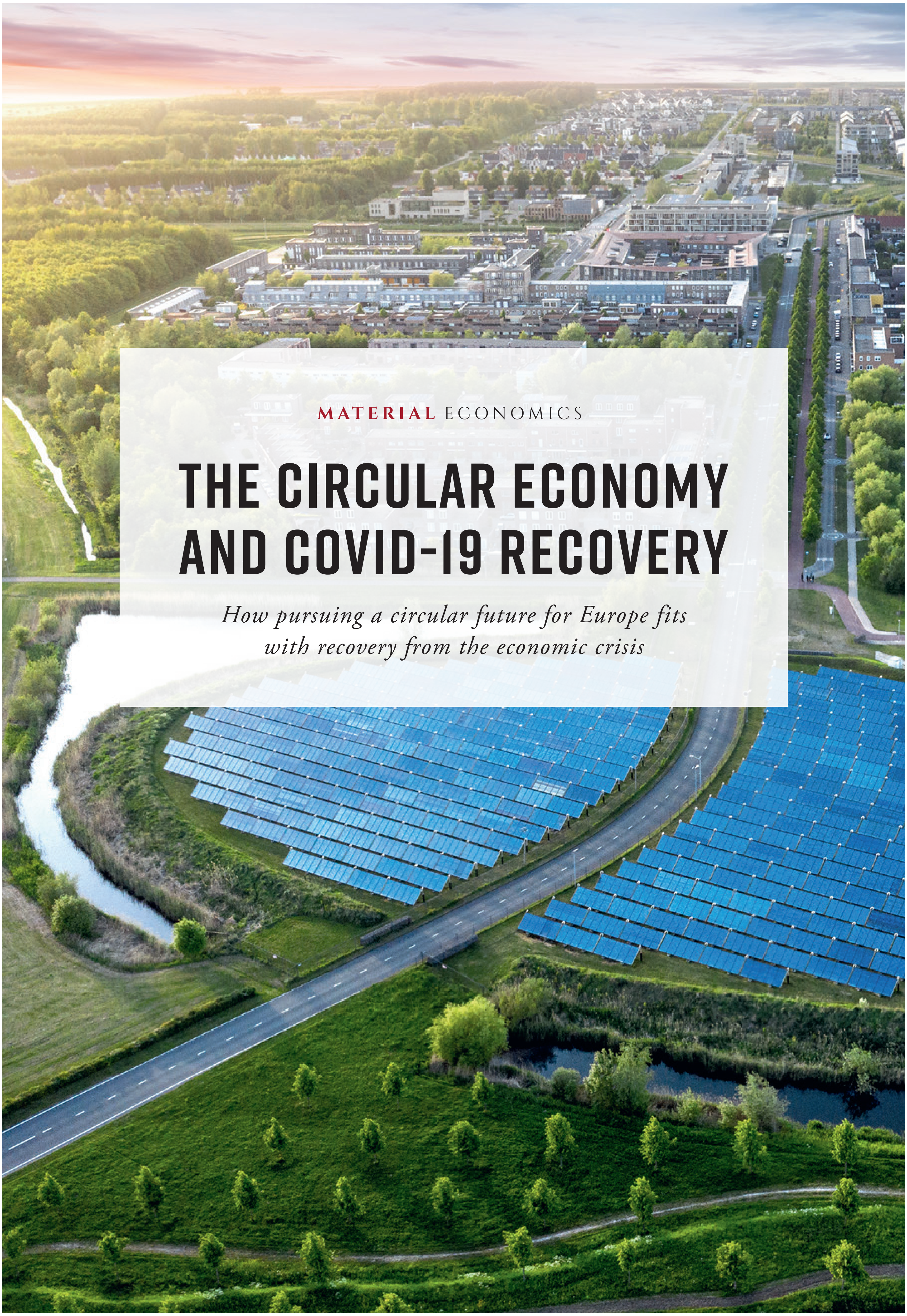

MATERIAL ECONOMICS

# THE CIRCULAR ECONOMY AND COVID-19 RECOVERY

*How pursuing a circular future for Europe fits with recovery from the economic crisis*

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# PREFACE

**The COVID-19 pandemic** has been catastrophic, with nearly 34 million confirmed cases and over 1 million deaths as of 30 September 2020, and severe economic impacts around the world. As policy-makers grapple with this public health crisis, they also face the need to mobilise recovery efforts to revitalise an economy hit by the effects of the pandemic. EU leaders rightly recognise this as a watershed moment: major investments are in preparation both at the EU level and within Member States, and they could shape the continent's economic development trajectory for many years.

**EU leaders have clearly stated** that the COVID-19 economic recovery must go hand in hand with other strategic priorities: an economy more resilient to future shocks, capturing the opportunities of digitisation, finding sources of industrial renewal, and meeting climate targets. In this report, we focus on the role of the circular economy in the recovery. We examine the potential benefits in the context of the EU's COVID-19 recovery priorities and lay out an agenda for action. We find that a transition to a more circular economy can make significant contributions to EU priorities for resilience, jobs, and environmental protection, while also offering a major opportunity in pure economic terms – both near-term stimulus and longer-term productivity.

**There is a need to act fast,** to safeguard the momentum that had already built up behind the circular economy, seize opportunities for economic stimulus, and set the right course for the EU to 2030 and beyond. European leaders have expressed a desire to include the circular economy in recovery plans, and some countries are already taking steps in that direction. We hope that the analysis presented in this paper will support such efforts.

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# EXECUTIVE SUMMARY

**Europe entered the current** economic crisis with a strong commitment to a more circular economy: an updated EU Circular Economy Action Plan as part of the Green Deal, national circular economy plans adopted by many Members States, and a gathering momentum for circular business models.

**At the same time,** 2020 is a year of unprecedented economic shock. The COVID-19 pandemic has damaged health and disrupted economic life, with consequences that will be with us for many years. As businesses and citizens prepare for this new operating environment, policy-makers are also responding. The Next Generation EU and analogous national stimulus programmes will shape European economic development for years to come.

**An important element** of the EU's climate strategy prior to the COVID-19 crisis was to transition to a more circular economy. This paper revisits the economic case for that transition in the context of Europe's priorities for COVID-19 recovery, examines how circular economy measures align with the recovery, and identifies policy priorities to maintain momentum for the transition and make the most of opportunities for near-term economic stimulus. In the next pages, we summarise the three main findings.

# I. THE CIRCULAR ECONOMY REMAINS AN ATTRACTIVE LONG-TERM ECONOMIC VISION FOR EUROPE.

**A large body of work** has showed a wide range of benefits from a more circular economy – with strong affinity to EU strategic priorities. Circular business models mobilise local resources to reduce import dependence and diversify supplies for greater resilience. They are typically labour-intensive, which by some estimates could create 650 000–700 000 net jobs by 2030. The circular economy can also make a major contribution to EU climate targets, reducing greenhouse gas emissions from EU materials use by almost 300 million tonnes $CO_2$ (more than 50%) per year by 2050. At the same time, by reducing the cost of essential services such as mobility and food, it would particularly benefit lower-income households, promoting greater equality. European leaders already recognise this potential.

**Research also suggests** significant economic gains from a circular economy transition. In this study, we update existing estimates to the 2020 context and find that much of this economic opportunity is still available and relevant. By 2030, an ambitious pivot to a more circular economy could reduce the total cost of providing goods and services in key EU value chains (mobility, housing and food) by as much as EUR 535 billion per year. This corresponds to a 15% productivity improvement in value chains that make up 60% of household spending. Put in the context of an average household in the EU, savings correspond to 2400 EUR per household and year, similar to the total expenditure on utilities and insurance for housing. It would come through multiple channels: more productive use of capital assets; more efficient production and resource use in core value chains; and access to a greater range of productive resources. The impact on GDP could be 2–4 times larger, through additional (multiplier) effects in the economy. A circular economy transition thus remains highly relevant as a source of economic growth and renewal for the 2020s.

## 2. THE CIRCULAR ECONOMY CAN FORM PART OF RECOVERY EFFORTS BOTH THROUGH NEAR-TERM STIMULUS AND AS A SOURCE OF LONG-TERM ECONOMIC GROWTH AND RENEWAL.

**The longer-term potential** in a more circular economy raises an obvious question for 2020: How should policy- and business decision-makers act in the context of the current economic crisis?

**First, we identify a need** to safeguard existing circular economy momentum and activity. Many EU businesses and cities are already reconfiguring their activity, often supported by policy. This is now challenged on multiple fronts: disrupted supply chains, a fall in the price of raw materials, reduced investment, and worsening liquidity. Especially at risk are recycling investments, and a broad set of SME start-up activities and company strategies for greater circularity. We estimate that EUR 50–70 billion per year in benefits by 2030 could be forgone if current momentum is delayed, depending on how deep the economic crisis becomes. It is important to protect the progress already made, maintain the momentum, and avoid future delays.

**Second, there are activities** that can directly contribute to near-term economic recovery – even with strict criteria for "timely, targeted, and temporary" stimulus. The largest category is a set of investment opportunities that could mobilise resources (labour and capital) that otherwise risk lying idle or being underutilised in an economy with low aggregate demand. The circular investment agenda spans a wide range of activities, from cities infrastructure, to new vehicle platforms, building renovations, and sorting and recycling infrastructure. There are also circular economy business models with near-term potential, such as telecommuting and online grocery shopping. Together, they could enable as much as EUR 160 billion of value creation in 2030 – making them prime options for "win-win" recovery efforts, as they will also enable the needed transition to a circular economy.

**Third, we assess the near-term costs** and benefits of circular activities given the current focus on economic recovery. We weigh near-term net costs (including reduced externalities), the timing of costs and benefits, the potential for innovation, and the risk of unintended costs. We find that much of the circular economy potential identified is broadly similar in pure cost terms to current practices (especially if total costs over products' lifetime are accounted for), and with limited risk for downsides. Only some 10–25% of the potential comes with near-term net transition costs; the lower end of the range if the contributions to environmental objectives are accounted for, the higher if these are ignored. A large share of the pre-COVID agenda thus remains highly relevant, from many practices of more resource-efficient construction, to initiatives to reduce waste in manufacturing, the gradual introduction of digital technology for precision agriculture, and R&D efforts in areas such as textile recycling and chemical recycling of plastics. Policy-makers and businesses can continue to pursue the circular economy agenda without concern that it would lead to large increases in costs or divert important resources during the crisis.

*Exhibit 1*

# THE CIRCULAR ECONOMY IS A MAJOR ECONOMIC OPPORTUNITY WITH CONTINUED RELEVANCE DURING THE ECONOMIC CRISIS

**REDUCTION IN RESOURCE COST[1] IN MAJOR VALUE CHAINS BY 2030**
EUR BILLION PER YEAR

MOBILITY
BUILT ENVIRONMENT
FOOD

**EUR 535 BN OF ECONOMIC VALUE BY 2030...**

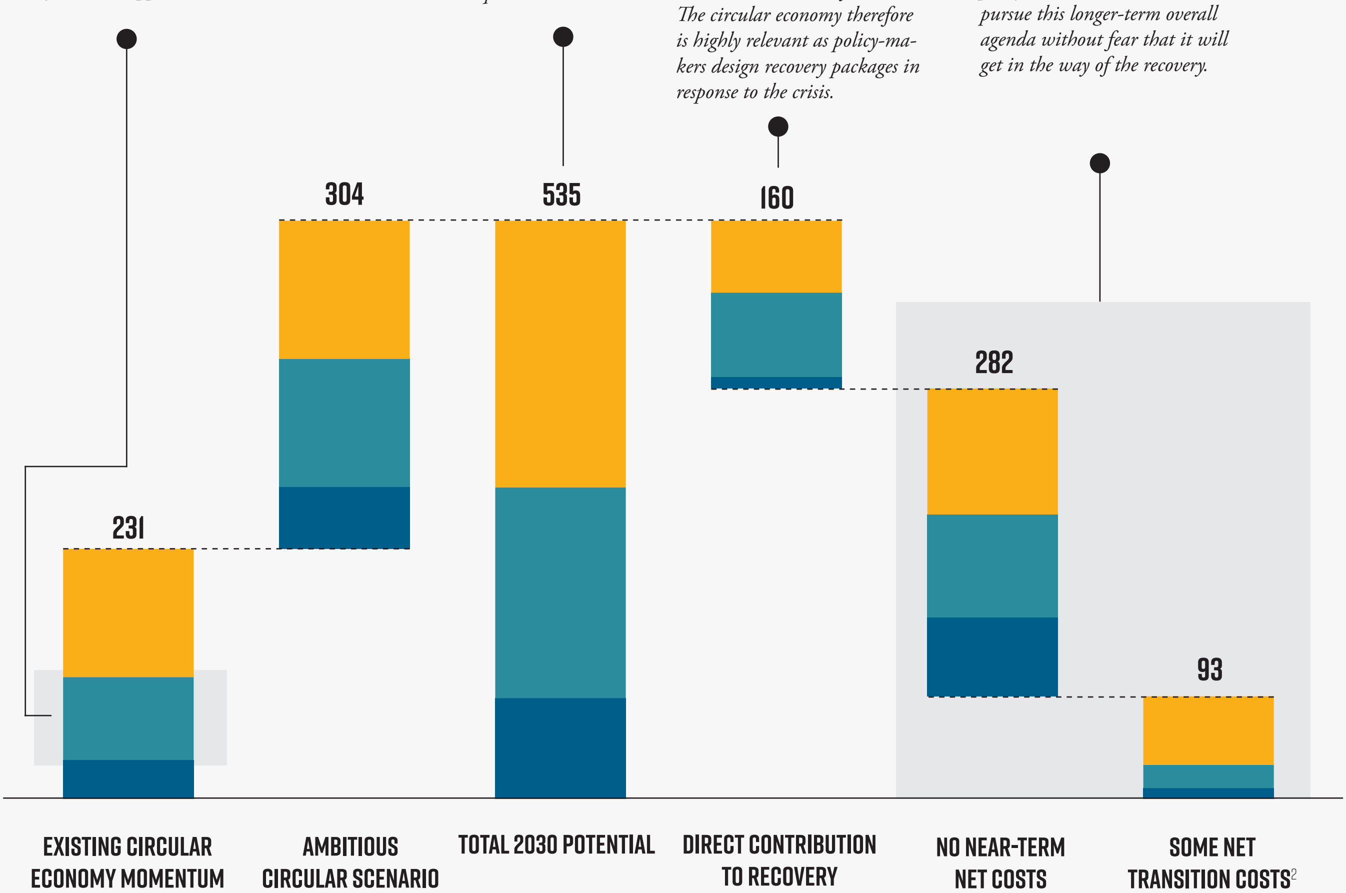
**... WITH RELEVANCE TO NEAR-TERM RECOVERY EFFORTS**

**AN ONGOING TRANSFORMATION AT RISK**
*EU companies, cities and countries are already turning to the circular economy, but COVID-19 poses risks and can delay the transition. Policy can help safeguard the existing momentum through targeted financial support.*

**A MAJOR LONG-TERM ECONOMIC OPPORTUNITY**
*A clear joint vision and commitment is key to mobilising the investment, innovation, and business initiatives required to achieve this.*

**A MAJOR NEAR-TERM STIMULUS OPPORTUNITY**
*There are major "win-win" opportunities with actions – especially investments – that can stimulate the economy in the near term while unlocking long-term circular economy value. The circular economy therefore is highly relevant as policy-makers design recovery packages in response to the crisis.*

**A HIGHLY RELEVANT AGENDA IN THE CRISIS**
*Much of the potential depends on overcoming near-term barriers to long-term value. While there are some examples of transition costs, companies and policy-makers can continue to pursue this longer-term overall agenda without fear that it will get in the way of the recovery.*




**NOTES:** [1]RESOURCE COST REFERS TO THE TOTAL COSTS OF ECONOMIC ELEMENTS OR INPUTS USED TO PERFORM ACTIVITIES, INCLUDING LABOUR COST, COST OF MATERIALS, SUPPLIES, EQUIPMENT, TECHNOLOGIES, ETC. THIS THUS INCLUDES BOTH OPERATIONAL AND CAPITAL COSTS. [2]POTENTIAL CALCULATED BASED ON MEASURES WITH NET NEAR TERM COSTS. THE SHARE OF THE POTENTIAL WITH SUCH NET COSTS IS ESTIMATED AT 10% OF THE POTENTIAL WHEN EXTERNALITIES ARE ACCOUNTED FOR, BUT CLOSER TO 25% IF THESE ARE IGNORED. THE NUMBER GIVEN IN THE FIGURE IS AN AVERAGE OF THESE TWO.

**SOURCE:** MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM ELLEN MACARTHUR FOUNDATION (2015) BY THE SUN FOUNDATION.

# 3. NEAR-TERM ACTION IS IMPORTANT

**The Circular Economy Action Plan** and other policies already address many aspects of the circular economy transition, but the economic crisis adds another layer of complexity. We investigate how policy can act on the different categories of measure we identify above: to safeguard existing momentum, capture opportunities for stimulus, or support the continued pursuit of long-term value. We do not investigate the merits of specific policy instruments and thus do not offer specific recommendations. Instead we analyse four broad roles that policy can take:

**1. Set directions and targets:** Articulate a commitment to a future, more circular economy via clear high-level targets; integrate the circular economy with other agendas (e.g. industrial or digital strategy); and track progress via agreed metrics.

**2. Create enablers and remove barriers:** Address multiple non-financial barriers to the circular economy transition within the EU with tools such as product standards, revising regulation, improved transparency, etc.

**3. Make the economics work:** Level the playing field via measures such as subsidies, taxation, trade policy, or measures to create lead markets, and stimulate demand via quotas, content requirements, etc.

**4. Make public investments:** Direct use of public funds, either by acting as an investor (e.g. in infrastructure), or by providing concessionary or blended finance solutions for private investment.

Using this framework, four key areas for action emerge for the circular economy agenda during the economic crisis:

*i) Signal continued commitment:* The pandemic and the resulting economic crisis have created increased uncertainty, spilling over to circular economy efforts that are often still in early stages. In this setting, a credible policy commitment is very important. The EU already has some sector- and some product-specific targets, but could consider overarching targets across all elements of circular economy: 1) increased capital productivity through increased lifetime and utilisation of capital assets and durable products, 2) reduced waste and increased efficiency in the product and materials use of key value chains, and 3) mobilisation of new resources through effective and high-value circular materials systems. Doing so would help measures that are now at risk from the crisis, make stimulus more effective, and provide a foundation for a longer-term transition.

*ii) Safeguard the current momentum through targeted financial intervention:* The crisis can motivate temporary measures to keep circular activities afloat. This includes targeted and temporary financial support for disrupted supply chains (e.g. within recycling); support financial measures linked to crisis-specific factors (such as the economic fallout from changes in raw materials prices) where these otherwise risk causing long-term damage to EU circular economy capacity; and direct intervention towards planned investments that risk being postponed or cancelled specifically due to the crisis.

*iii) Incorporate the circular economy in stimulus programmes:* Policy-makers can include the circular economy in stimulus programmes primarily through a role as direct investors. The circular economy transition presents a broad agenda of investments that could be included in such programmes. Public investments also tend to leverage many-times larger investments from the private sector, further revitalising the economic recovery as well as the circular economy implementation.

*iv) Continue to pursue long-term value through a coherent circular economy policy framework:* Much of the circular economy potential cannot be driven by one-off interventions of rescue packages or public intervention. For much of the circular economy transition, a complete and systematic policy framework to address barriers and gradually shift the economic case remains highly relevant.


ENTRY
ONLY

# 1. INTRODUCTION

**The COVID-19 pandemic** has been catastrophic, with nearly 34 million confirmed cases and over 1 million deaths as of 30 September 2020, and severe economic impacts around the world.[1] Governments have struggled to protect public health and control the spread of the virus while also helping households and businesses affected by shutdowns and drastic reductions in income. Many supply chains have also been disrupted, forcing companies to realign their operations in a deeply uncertain environment.

**As policy-makers grapple** with this public health crisis, they also face the need to mobilise recovery efforts to revitalise an economy hit by the effects of the pandemic, with major public investments both at the EU level and within Member States. To succeed, Europe will need to tap into multiple sources of growth and value creation – from digitisation to innovation, improved infrastructure, deeper skills and education, and further economic integration. As EU leaders recognise, this is a watershed moment: The response to the pandemic through the Next Generation EU fund and national initiatives could shape the continent's economic development trajectory for many years.

**EU leaders have put sustainability** at the heart of the COVID-19 recovery, explicitly linking it to the European Green Deal and prioritising investments in renewable energy, electrification of transport, and other climate priorities. This paper focuses on another major opportunity for a "green" recovery, also aligned with EU priorities: investing in a more circular economy. Officials have expressed a desire to include this in recovery plans, and some countries are already taking steps in that direction.

**We examine the circular economy** transition in the context of the COVID-19 crisis and recovery, looking at three questions in particular:

- What is the economic opportunity presented by the transition to a circular economy in 2020? A rich body of research has shown how the circular economy can improve productivity, reduce costs, and drive investment, business creation and employment, while boosting resilience and protecting the environment and human health. In Section 2, we provide an update in the context of 2020 and lay out scenarios to 2030, as a guide for decision-makers.
- How does the circular economy agenda fit with the EU's priorities for economic recovery? Both the COVID-19 crisis and policies and programmes to address it have implications for the circular economy transition, and circular economy initiatives may advance economic recovery goals. In Section 3, we identify opportunities for "win-win" actions that provide near-term and accelerate the circular economy transition, and also consider potential trade-offs between the two.
- What near-term actions are needed to maximise benefits to the EU economy? The COVID-19 crisis arrived as the EU was preparing a major new wave of initiatives to further accelerate the transition to a circular economy. We identify an agenda for action to help maintain the momentum while maximising synergies with COVID-19 recovery.

**Investing in the circular economy** transition as part of the EU's COVID-19 recovery would not only foster long-term economic productivity and regeneration, but also strengthen the foundation of resilience, sustainability and inclusion on which EU leaders aim to rebuild the economy. It would enable Europe to better withstand future shocks, capture key opportunities of digitisation, help revitalise industry, and support the achievement of climate targets. Near-term choices therefore can contribute to deep systems transformation.[i]

**Decision-makers will need** to act fast to set the course through the current economic crisis. Time is also of the essence for many of the economic opportunities we discuss here. We hope that this report helps policy-makers and businesses as they prioritise actions and investments.

[i] *This report investigates the economic potential in such deep change as it relates to the circular economy; for a more comprehensive analysis of systems change as it relates to the EU Green Deal, see SYSTEMIQ's forthcoming report on "A System Change Compass".*

*The response to the pandemic through the Next Generation EU fund and national initiatives could shape the continent's economic development trajectory for many years.*

# 2. THE CIRCULAR ECONOMY: A MAJOR OPPORTUNITY FOR EUROPE

**A robust body of research** showing the benefits of a more circular economy has led EU policy-makers to recognise this as a major economic opportunity. Indeed, the transition could play a key role in ensuring that European industry remains globally competitive and a leader in innovation in the decades ahead. In this section, we take a fresh look at the evidence to quantify the potential. By 2030, we estimate that a pivot to a more circular economy could capture more than EUR 535 billion of value[2] by boosting European productivity and economic activity.

**The opportunities are wide-ranging**, spanning across value chains that constitute about 60% of household spending: mobility, built environment/cities and food.[3] The economic boost is provided by a range of mechanisms, from increased utilisation of capital assets, to reduced waste and increased efficiency, to mobilisation of new resources and production systems. In addition, a transition to a more circular economy would make the EU economy more resilient and could significantly reduce greenhouse gas (GHG) emissions, by nearly 300 million tonnes $CO_2$ per year by 2050.[4]

**In the sections that follow,** we outline the key areas in which the circular economy would add value, quantify the economic benefits, based on existing studies, and look more closely at how the transition would also boost resilience and contribute to social objectives and reduction of GHG emissions. Box 1 summarises our analytical approach.

*A transition to a more circular economy would make the EU economy more resilient and significantly reduce GHG emissions.*

## 2.1 THE CIRCULAR ECONOMY OFFERS AN AMBITIOUS VISION FOR VALUE CREATION

**We take a broad view** of the circular economy as one that maintains the value of products, materials and resources for as long as possible, while minimising the generation of waste and regenerating natural systems. This spans a broad agenda, from incremental increases in the reuse, repair or recycling of materials and products, to systemic changes in shared mobility, regenerative agriculture, the use patterns of buildings, or service models for a range of consumer goods. All have in common a major shift: from an economy highly dependent on the continued new supply (and rapid disposal) of resources and energy, to one that mobilises new sources of value, based on new inputs such as increased use of data, advanced logistics, labour and natural systems.

**These principles,** in turn, give rise to a broad range of economic strategies and business opportunities for companies as well as for governments, cities and households (Exhibit 2). In various ways, they increase the utilisation of physical assets, prolong their life, improve efficiency, reduce waste, and shift resource use from finite to renewable sources. Profitable opportunities arise across all industries. Digitisation is often a key enabler, reducing transaction costs, enabling coordination and overcoming information barriers that had hindered action in the past.

*Exhibit 2*

## THE RESOLVE FRAMEWORK DEFINES A BROAD SET OF OPPORTUNITIES FOR VALUE CREATION THROUGH A MORE CIRCULAR ECONOMY

| | EXAMPLES |
|---|---|
| REGENERATE | *Shift to renewable energy and materials*<br>*Reclaim, retain and restore health of ecosystems*<br>*Return recovered biological resources to the biosphere* |
| SHARE | *Share assets (e.g. cars, rooms, appliances)*<br>*Reuse/secondhand*<br>*Prolong life through maintenance, design for durability, upgradability, etc.* |
| OPTIMISE | *Increase performance/efficiency of product*<br>*Remove waste in production and supply chain*<br>*Leverage big data, automation, remote sensing and steering* |
| LOOP | *Remanufacture products or components*<br>*Recycle materials*<br>*Digest anaerobically*<br>*Extract biochemicals from organic waste* |
| VIRTUALISE | *Books, music, travel, online shopping, autonomous vehicles, etc.* |
| EXCHANGE | *Replace old with advanced non-renewable materials*<br>*Apply new technologies (e.g. 3D printing)*<br>*Choose new product/service (e.g. multimodal transport)* |

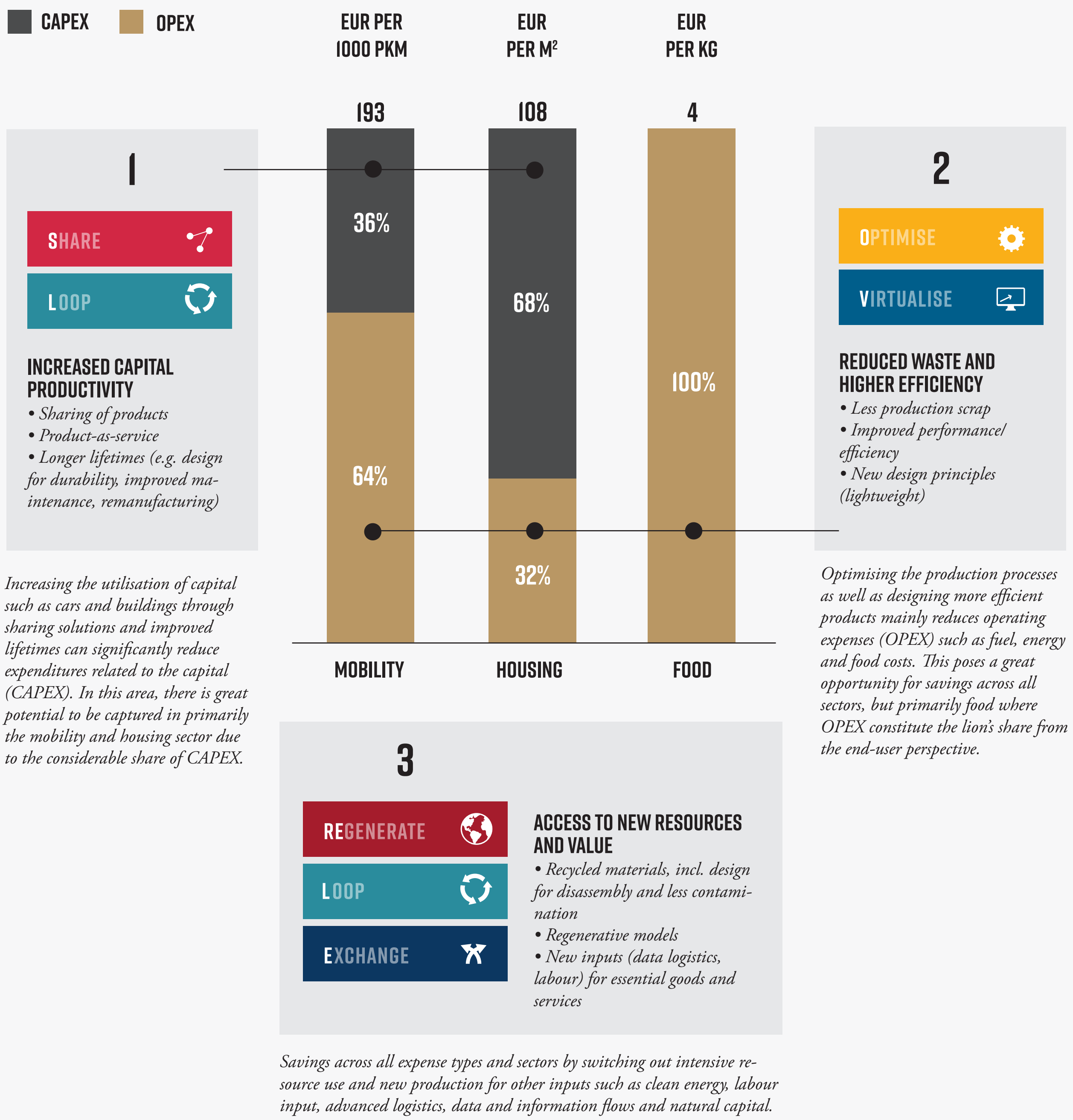
**SOURCE:** ELLEN MACARTHUR FOUNDATION (2015), GROWTH WITHIN.[5]

**For economic decision-makers,** the question is how this relates to the topic of economic recovery and growth. There is in fact a close link, through several different mechanisms.

**A more circular economy** can improve the productivity of capital assets, reduce waste and improve the efficiency in the production of goods and services, and diversify and expand the resource base of the economy (Exhibit 3).

*Exhibit 3*

## A MORE CIRCULAR ECONOMY CREATES ECONOMIC VALUE THROUGH THREE MAIN ROUTES




**SOURCE:** MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM ELLEN MACARTHUR FOUNDATION (2015)[6] AND THE SUN FOUNDATION.[7]

## INCREASED PRODUCTIVITY OF CAPITAL ASSETS

**Capital costs make** up a large share of major household expenditures, notably in the case of mobility, housing, and durable consumer goods. For example, capital costs make up 36% of household mobility expenditures (see Exhibit 3). Yet many core capital assets even in long-established value chains are underutilised – from cars, to offices, to electronics, effective utilisation and/or service lifetimes are much lower than they could be. As a rich body of work shows, there are significant opportunities to prolong the lifetimes of major classes of durable goods and capital assets without compromising on innovation or quality.

**These range from incremental** strategies to increase lifetimes (e.g. through maintenance, repair, remanufacturing and reuse of components or products), to large system shifts in how products are used to provide essential goods and services. Mobility provides a striking example. As shown in Exhibit 4, a shift to a mobility system with high utilisation and longer lifetimes for vehicles can unlock large sources of value: lower cost per passenger-kilometre, a significant drop in resource use, and much lower environmental impact.[8] This is also a major opportunity for businesses; for example related to providing car-sharing and ride-sharing services.

**The same principles** are applicable to a range of other sectors and opportunities: from space-sharing in buildings; to pooling of durable household goods, machinery and other assets; to improved use of existing infrastructure; to extended lifetimes through reuse, maintenance, repair and remanufacturing. The result is a reduction in total cost of ownership for major economic systems, improving productivity and freeing up resources for other use. The key enabler is often digitisation, which reduces transaction costs that previously have stood in the way. To fully unlock the potential, "upstream innovation" is often key: improved capital productivity often depends on products being designed for it, and on agreed standards throughout the value chain.

## REDUCED WASTE AND HIGHER EFFICIENCY

**Major value chains** are prone to high levels of waste: deep structures that lock in high resource use and thus often unnecessarily high costs and exposure to price volatility. New technologies and business models can help provide the same level of services (passenger-kilometres of transportation, protection for packaged goods, calories of high-quality food, etc.) with much less input in production. For example, about 15% of buildings materials are wasted in the construction phase, while overuse of structural steel and concrete elements can be as high as 50%;[9] precision agriculture can reduce the need for chemical inputs by 30–40%;[10] and many core manufacturing processes have yield losses of materials of as much as 40–50%.[11]

**In many cases,** these inefficiencies arise because the transaction costs of reducing them are too high. Business opportunities to eliminate these inefficiencies correspondingly also depend on a combination of new technology, data-driven customisation, more sophisticated inventory and logistics, and in some cases a switch to more labour inputs. They are often held back by legacy systems: regulations, contract structures, risk sharing systems, and low penetration of digital solutions. However, technology is rapidly changing this. For example, new digital platforms and sensors are enabling a market for selling food close to its expiry date that was not previously viable (see Exhibit 5).

**Added together,** these opportunities can substantially reduce the resource cost of major value chains in the economy. This can have a major multiplier effect, by freeing up resources for investment and consumption elsewhere in the economy, ultimately contributing to GPD growth. It also offers a wide variety of business opportunities, such as cost savings for companies (e.g. estimated EUR 10 billion saved material cost in 2030 from 3D printing)[12] or new circular markets (e.g. car-sharing companies or recycling markets – the aluminium recycling market today is EUR 3 billion, but it could increase to EUR 12 billion in 2050 with a higher recycling rate).[13]

# ANALYTIC AND MODELLING APPROACH

**Our analysis builds** on a rich suite of models and analytical tools on the circular economy. We estimate the economic potential in 2020–2030 based on the modelling developed for Growth Within (2015) by the SUN Foundation,[14] with a detailed modelling framework for the investments, costs and resources used in three major value chains – mobility, the built environment and food – that jointly make up around 60% of EU household expenditures.[15] The models also detail the effect of a range of circular economy strategies on these costs and resource use patterns, making it a highly useful tool for exactly the questions we seek to answer in this report.

**We update the model** by updating the baseline and scenarios to reflect developments (economic, technology and policy) since the original work was undertaken, and by building in additional analyses and insights that have emerged since Growth Within was published, including an economic analysis of the EU materials system;[16] a further analysis of investment opportunities;[17] and a set of deep dives and case studies in other value chains (chiefly textiles, durable consumer goods and packaging).[18]

**We express the long-term** potential of a more circular economy in savings on resource costs: the total economic elements or inputs used to perform activities. This includes salaries, as well as the cost of materials, supplies, equipment, technology and facilities. It is closely linked to productivity: in all cases, we assume the same level of service for end-users, so reduced resource costs imply an increase in total productivity. Reduced resource costs, in turn, can have multiplier effects, as resources are freed up for other use in the economy, both consumption and investment (and in some cases, if underutilised resources are put to productive use). The total impact on GDP is thus generally larger than the resource cost savings. Growth Within found a multiplier of 2–4.5 was common for the types of measures considered in this report.[19]

**We also quantify** various non-economic effects. We value the reductions of externalities, including congestion, air pollution, accidents, and $CO_2$ emissions. However, we report these separately, so the headline numbers for economic benefits are all expressed purely in terms of resource cost. Finally, we assess several benefits qualitatively rather than quantitatively. For example, the goods and services we model typically make up a greater share of household spending for low-income households than for high-income households, so a reduction in cost therefore may reduce inequality.

**To assess the overlap** between the circular economy agenda and EU's road to recovery from the COVID-19 crisis, we focus on two questions:

**Stimulus potential:** Does the action mobilise resources that otherwise would be left idle in an economy with faltering aggregate demand? The resources here can be labour (via unemployment at levels higher than what accelerates inflation or exceeds what is "natural" for the economy), capital (via low-capacity utilisation in various value chains), or natural resources that are left untapped instead of fuelling economic activity. This is where the opportunity for stimulus arises: in principle, actions that use external funds (e.g. from borrowing or from quantitative easing) to put such resources to use that can enable higher growth. This opportunity for stimulus generally arises only in exceptional circumstances, such as those generated by a deep recession, but have little benefit when the economy is already working at or near full capacity. The EU is already preparing major interventions, via the RRF and national policies, to address this agenda.

**Near-term net costs:** Do benefits in the near term exceed the costs that arise? This concerns not whether resources are put to use, but a) how productive that use is (can we reduce costs now, and thus free up resources for other uses?) and b) shifts from one type of economic activity to another. "Cost" here must be carefully defined: we stick to the current conventions of GDP and do not include externalities. However, as we discuss below, including natural capital in the equation can often tilt the balance for circular economy measures.

**These two assessments** can jointly be used to investigate how circular economy measures align with current economic priorities.

## B.
## DO NEAR-TERM ECONOMIC BENEFITS OUTWEIGH NEAR-TERM COSTS?

| A. DOES IT MOBILISE IDLE RESOURCES WITHIN 5 YEARS? | ECONOMIC BENEFITS < COST *in the near term* | ECONOMIC BENEFITS = COST *in the near term* | ECONOMIC BENEFITS > COST *in the near term* |
|---|---|---|---|
| YES | NO NEAR-TERM NET COST | DIRECT CONTRIBUTION TO RECOVERY | DIRECT CONTRIBUTION TO RECOVERY |
| NO | SOME NET TRANSITION COST | NO NEAR-TERM NET COST | DIRECT CONTRIBUTION TO RECOVERY |

• **DIRECT CONTRIBUTION TO RECOVERY** *comprises actions with potential to mobilise idle resources near-term that outweigh high near-term economic costs, or where there are strong near-term economic cost savings.*

• **SOME NET TRANSITION COSTS**, *i.e. activities where near-term economic costs outweigh near-term economic benefits without mobilising idle resources near-term. There is an important caveat here, in that the picture might change if costs were assessed together with valuing externalities. An important discussion is thus how much weight to place on health or environmental protection.*

• *Finally, activities with* **NO NEAR-TERM NET COST** *are those for which either an action has stimulus potential through near-term mobilisation of idle resources despite having a net negative near-term economic value, or actions that do not mobilise idle resources near-term, but have largely balanced near-term costs and benefits.*

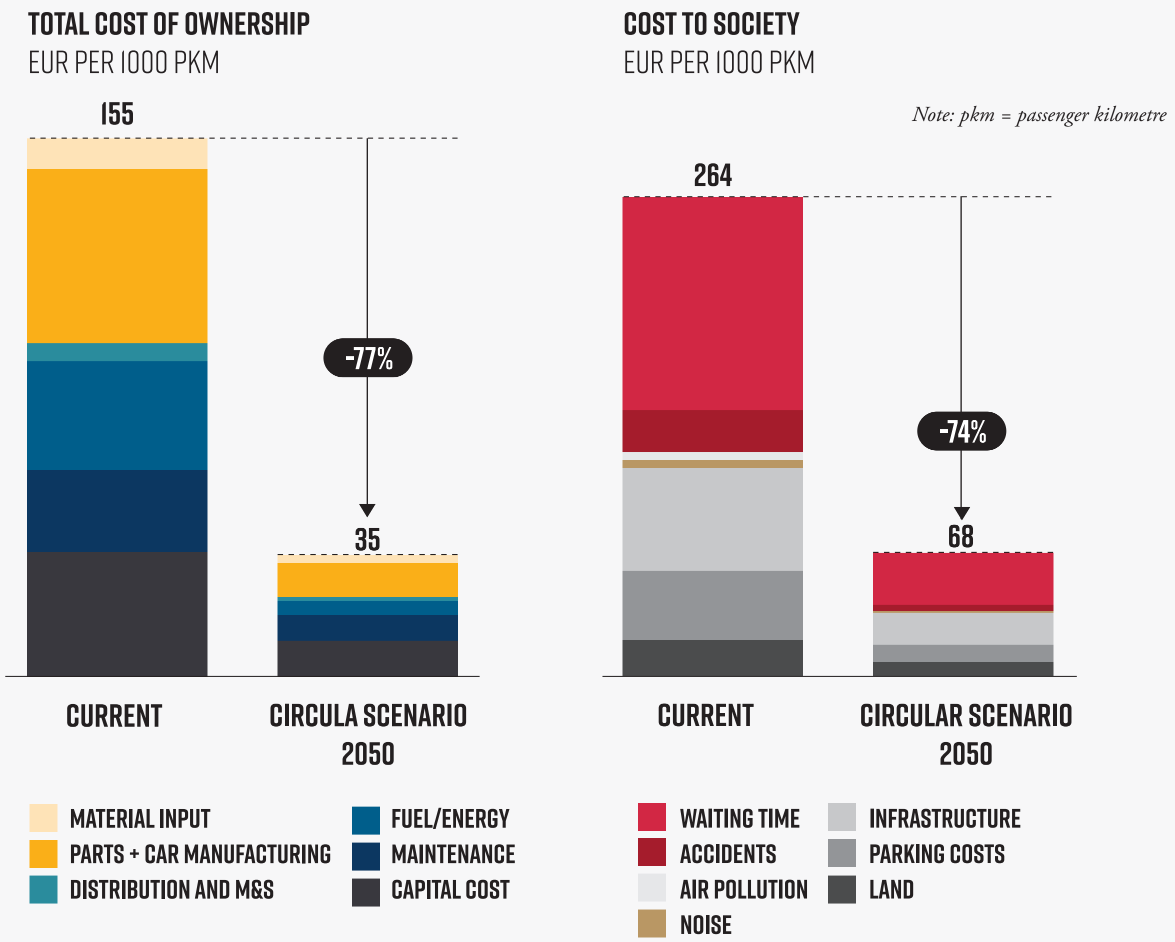
*These assessments can never be scientifically precise and depend on many uncertain factors, such as how long aggregate demand might be depressed, or how net costs might evolve given raw materials prices and other factors. Nonetheless, they can help us understand the structure of how the economic crisis aligns with the longer-term circular economy transformation.*

**SOURCE:** MATERIAL ECONOMICS ANALYSIS, SEE ENDNOTE.[13]

*Exhibit 4*

# AN INCREASED UTILISATION OF CAPITAL ASSETS CAN SIGNIFICANTLY LOWER BOTH CONSUMER AND SOCIETAL COSTS

CASE STUDY: CAR-SHARING




**Substantial economic value** can be created by combining increased utilisation of capital assets, improved design for less waste and higher efficiency, and access to new resources. Personal mobility, an essential enabler of economic life, is a good example.[20]

**Europeans spend as much as 15%** of household budgets on mobility[21] and the large majority (83%) of passenger travel today is in individual cars.[22] However, this individual car system is wasteful; the average car in the EU is parked 92% of the time and, when used, carries only 1.5 passengers on average – resulting in a 2% utilisation rate on average.[23]

**A shared car system,** based on professionally managed car fleets, could help unlock savings both for the consumer and society. Car-sharing means much higher utilisation of each vehicle, which in turn justifies much higher upfront costs. This enables shifts to the more expensive electric drivetrains, more advanced automation technology and higher performance materials. Professionally managed fleets also enable greater control over vehicle maintenance, reuse of components, and remanufacture. In combination, these factors enable vehicles with much longer lifetime, as measured in kilometres travelled. Sharing of vehicles also makes possible a much closer match of vehicle size to the needs of individual trips, thus reducing the average size of vehicles substantially. All in all, this would increase productivity and reduce total cost of ownership substantially. From a societal perspective, increased car-sharing would yield further benefits, by reducing air pollution, noise, congestion, accidents and $CO_2$ emissions. The costs of congestion, for example, amount to as much as 2% of GDP in major cities.[24] In fact, the systems effects of a shared mobility system could reduce costs to households and to society by more than 70%.[25]

**To get there in time,** major investments must be made. For example, electric vehicles must be built, and charging stations must be installed. Cars must be redesigned to meet the needs of a shared business model. Once mobility-as-a-service takes root, it creates the precondition for fleet-managed vehicles, enabling better and predictive maintenance, component reuse, remanufacturing, and more control over end-of-life flows. Digitalisation can be a key facilitator. By providing data on the state of components in real time, predictive maintenance becomes possible; by using smartphones and applications, a shared platform for asset-tracking could increase connectivity; and in the longer run, automation of cars helps remove many of the barriers to effective utilisation of vehicle fleets. Apart from investments, policy-makers can facilitate the transition towards a shared car system by recognising the negative effects of air pollution and congestion through regulations and policies. The European Commission's forthcoming Sustainable and Smart Mobility Strategy,[26] which, among other things, will apply product-as-a-service solutions to optimise infrastructure and vehicle use, is clearly a step in the right direction.

**SOURCE:** MATERIAL ECONOMICS (2018), THE CIRCULAR ECONOMY – A POWERFUL FORCE FOR CLIMATE MITIGATION.[27]

*Exhibit 5*

# A MORE CIRCULAR ECONOMY CAN BE ACHIEVED THROUGH INCREASED DIGITALISATION IN THE FOOD SECTOR

CASE STUDY: FOOD WASTE

*Every year 20% of food is wasted in the EU – more than half of it within households.[28] The European Comission's Farm to Fork Strategy[29] aims to cut food waste at retail and consumers level by half by 2030; the Circular Economy Action Plan echoes that goal.[30] Achieving this would save an estimated EUR 600 per household per year[31] and reduce $CO_2$ emissions related to food waste by 114 million tonnes.[32]*

**20%**

**OF FOOD IS WASTED**

*Every year in the EU*

**CUTTING THE FOOD WASTE BY HALF WOULD SAVE AN ESTIMATED**

**EUR 600**

**PER HOUSEHOLD PER YEAR**

*And reduce $CO_2$ emissions related to food waste*

**BY 114 MILLION TONNES**

**DIGITAL SOLUTIONS, OFTEN DRIVEN BY START-UPS, COULD PLAY A KEY ROLE IN REDUCING FOOD WASTE. EXAMPLES INCLUDE:**

- *Digital labels and sensors that can determine the actual expiration date, which typically prolongs the lifetime of the food;*
- *Digital marketplace platforms that enables restaurants to sell their close-to-expiration-date food for a discounted price;*
- *Analytical tools that predict the real lifetimes of products in stores, enabling optimisation of logistics based on the remaining lifetime.*

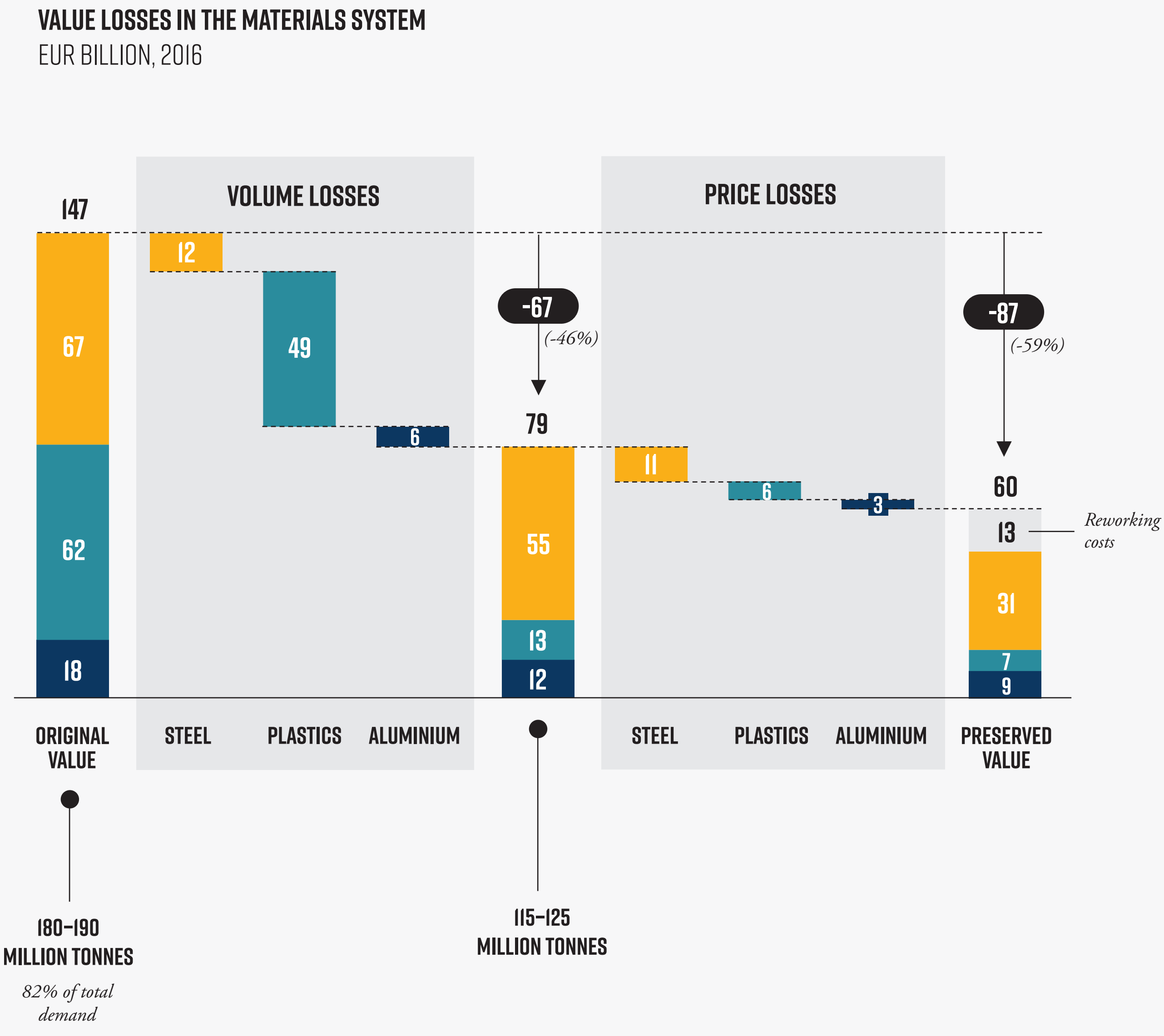
## ACCESS TO NEW RESOURCES AND VALUE

**The productive potential** of an economy also depends on the resources available to it: the technologies, raw materials, labour and capital it can mobilise. A more circular economy can expand this by making available new resources for the creation of economic value.

**For example,** as shown in Exhibit 6, materials worth EUR 140-150 billion reach the end of their useful life in the EU economy each year. Although these materials are all technically recyclable, only 41% of their original value is preserved due to both volume and price losses. Another example is the creation of new systems to make use of new, typically local inputs to produce goods and services. Notably, many circular business models rely on switching out intensive resource use and new production for other inputs, including clean energy, labour input, advanced logistics, data and information flows, and natural capital. This leads to a shift in economic activity, often accompanied by higher economic multipliers and increased job creation.

*Exhibit 6*

# MAINTAINING MORE OF THE VALUE OF MATERIALS IS A MAJOR ECONOMIC OPPORTUNITY FOR THE EU




**Each year, some 180–190 million tonnes** of steel, plastics and aluminium, originally valued at EUR 140–150 billion, reach the end of their useful life in the EU economy, after fulfilling essential roles in vehicles, buildings, products and packaging. However, only 41% of the original value is preserved – the rest is lost either through volume losses (e.g. material ending up in landfill or incineration instead of being recycled) or price losses (e.g. quality losses in the recycling processes). This suggests a substantial opportunity: If the EU could capture more of this material value, it could gain access to substantial new resources. It would also make EU less dependent on imports, create significant amount of new jobs and support EU to meet its climate targets.

**To fully capture that potential,** reducing value losses requires changes across major materials-using value chains. Example of actions include: partnerships along the value chains, improved waste management and recycling technologies, design for recyclability, take-back schemes, and subscription-based business models. All these opportunities have strong synergies with digitalisation, as new sorting technologies, tagging and tracking of materials, etc., make it possible to increase both volume and quality.

**SOURCE:** MATERIAL ECONOMICS (FORTHCOMING 2020), PRESERVING VALUE IN THE EU MATERIALS SYSTEM – A VALUE-PERSPECTIVE ON THE USE OF STEEL, PLASTICS, AND ALUMINIUM.[33]

## 2.2 A MORE CIRCULAR EU ECONOMY COULD CAPTURE EUR 535 BILLION PER YEAR OF VALUE BY 2030

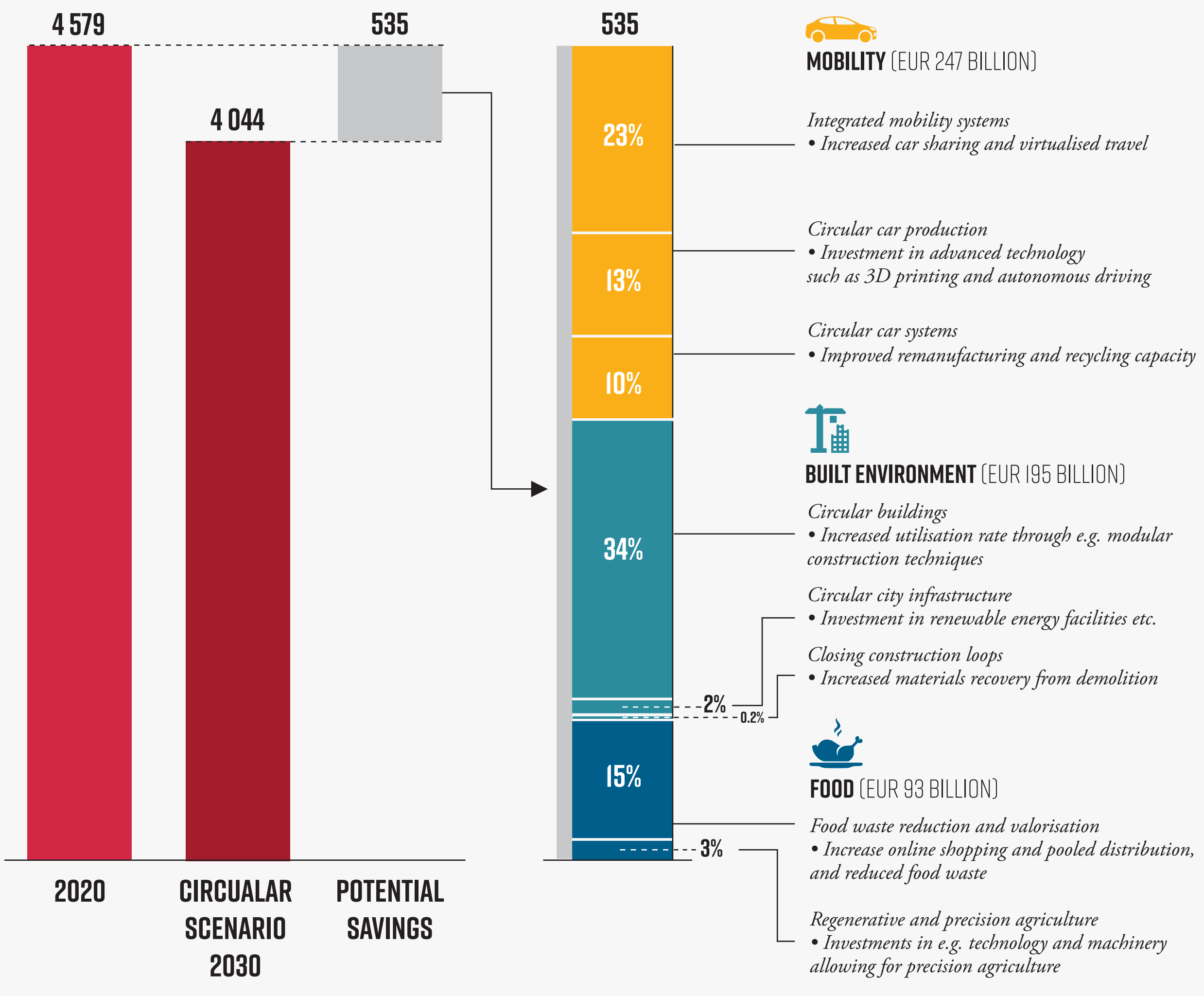
**The increased capital productivity** and utilisation, increased efficiency, and higher retained value enabled by a circular economy transition could provide a much-needed productivity boost for the EU. In this study, we define an ambitious circular scenario with rapid mobilisation of different circular economy actions in over 30 levers (see Appendix for details).

**Together, these actions** would reduce resource costs by as much as EUR 535 billion by 2030, corresponding to ~15% of total resource cost across mobility, housing and food (see Exhibit 7).

*Exhibit 7*

### AN AMBITIOUS CIRCULAR ECONOMY COULD UNLOCK EUR 535 BILLION PER YEAR BY 2030

**POTENTIAL RESOURCE COSTS AND SAVINGS FROM A MORE CIRCULAR ECONOMY**
EUR BILLION PER YEAR FOR MOBILITY, HOUSING AND FOOD, 2020 AND 2030




**NOTE:** NUMBERS MAY NOT ADD UP DUE TO ROUNDING

**SOURCE:** MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM ELLEN MACARTHUR FOUNDATION (2015)[34] AND THE SUN FOUNDATION.[35]

**Achieving that scenario** would require concerted efforts, however: in policy, innovation, investment, technology deployment and business creation. As we discuss in subsequent chapters, policy is especially important, at a more ambitious level than currently proposed.

**It is clear that the circular economy** is highly relevant to the economic challenges that the EU is now grappling with. Our estimates are also in line with prior studies, which show potential gains of 0.5–7% of GDP by 2030 (see Exhibit 8).

*Exhibit 8*

## EXAMPLES OF ESTIMATES FROM EXISTING STUDIES OF THE ECONOMIC IMPACT OF THE CIRCULAR ECONOMY

| REPORT | ECONOMIC BENEFIT FROM CIRCULAR ECONOMY |
|---|---|
| *Impacts of circular economy policies on the labour market (2018)* | **EUROPE** *GDP increase of +0.5% 2030. +700k jobs* |
| *Growth within (2015)* | **EUROPE** *GDP increase of +7% 2030* |
| *Opportunities for a Circular Economy in the Netherlands (2013)* | **NETHERLANDS** *EUR +7.3 billion. +54k jobs* |
| *The Circular Economy and Benefits for Society (2015)* | **SWEDEN, FINLAND, NETHERLANDS, FRANCE AND SPAIN** *+700k jobs in total from becoming 20% more material efficient* |
| *Study on modelling of the economic and environmental impacts of raw material consumption (2014)* | **EU** *Resource productivity improvements of ~2-2.5% p.a. can be achieved with net positive impacts.+2 million new jobs in the scenario of 2% improvement* |
| *European Commission Circular economy factsheet (2015)* | **EU** *Savings of EUR 600 billion for EU businesses. +580k jobs* |

## 2.3 A CIRCULAR ECONOMY TRANSITION WOULD ALSO CREATE SIGNIFICANT RESILIENCE AND CLIMATE BENEFITS, WHILE CONTRIBUTING TO SOCIAL OBJECTIVES

**The above focuses** on the conventional economic impact in terms of resource cost and GDP. But of course a major motivation for a more circular economy is that it can improve the quality, not just the quantity, of growth. In particular, circular economy solutions have a strong affinity with improving resilience, reducing GHG emissions, increasing equality and creating jobs – all priorities in the COVID-19 recovery.

### IMPROVED RESILIENCE THROUGH ACCESS TO A BROADER RESOURCE BASE

**The COVID-19 crisis** has alerted many companies to the downsides of very far-flung supply chains. The gains from trade must be weighed against price volatility, uncertainties in availability, and at worst, complete disruptions of supplies. Major EU companies are now considering options for protecting their own production from future shocks. "Reshoring" of production had already begun before the pandemic and is now set to increase.

**This is relevant to European industry** as a whole, not just individual companies. For example, the EU aluminium industry has struggled to compete with international supply, closing some production sites and increasing imports of primary metals. Some of this is structural (e.g. reflecting access to energy resources), but some is due to market prices that do not reflect the superior environmental performance of local production. The EU economy is building up a large stock of aluminium that will become available as vehicles, buildings, etc., reach their end of life. The volumes are such that recycled metal in principle could provide as much as 40% of the total need for aluminium by 2030, up from just 20% today – making it a major industrial opportunity. This industry could switch from importing extremely high-carbon metal and exporting low-value used aluminium, towards value creation through collection, sorting, remelting, and engineering of end-of-life flows. Achieving this, however, requires substantial investment and an overall course correction from current trends (Exhibit 9).

**This opportunity extends** to several other areas. End-of-life plastics can be a major source of feedstock for a future EU chemicals industry.[36] Likewise, the more than 20 million tonnes of steel scrap now exported every year[37] could find high-value uses in a future EU steel industry that merges new, low-carbon production routes for primary metal with higher use of recycled steel. Circularity thus meshes directly with the push for strategic autonomy articulated in the EU New Industrial Strategy for Europe.[38] Likewise, it is a major cornerstone in the EU Action Plan on Critical Raw Materials,[39] where a more circular economy seen as essential to achieving European resilience.

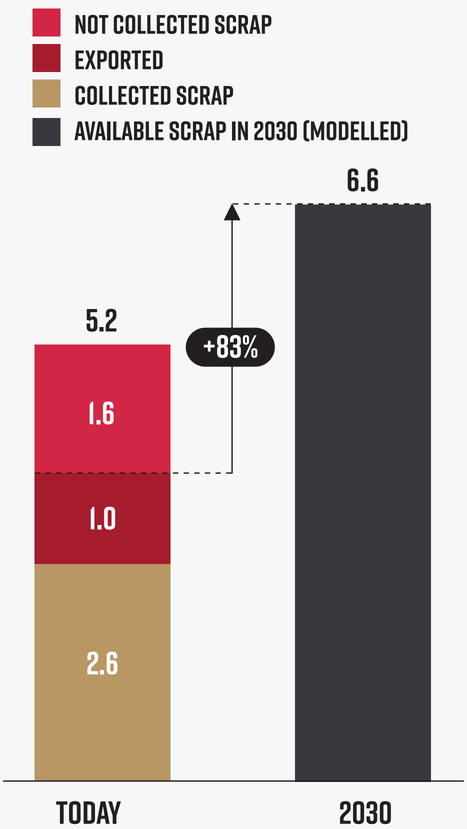
**None of this is to argue** for EU autarchy. Resilience is best served not by isolation, but by accessing as diverse and complementary a set of options as possible, and by creating as much flexibility as possible. Circular economy models open entire new supply options – adding to the total portfolio of resources available to the economy, broadening the input to key EU supply chains to include areas where EU has opportunity to excel, including advanced digitisation and local logistics.

*Exhibit 9*

# ALUMINIUM RECYCLING OFFERS A MAJOR INDUSTRIAL OPPORTUNITY FOR THE EU

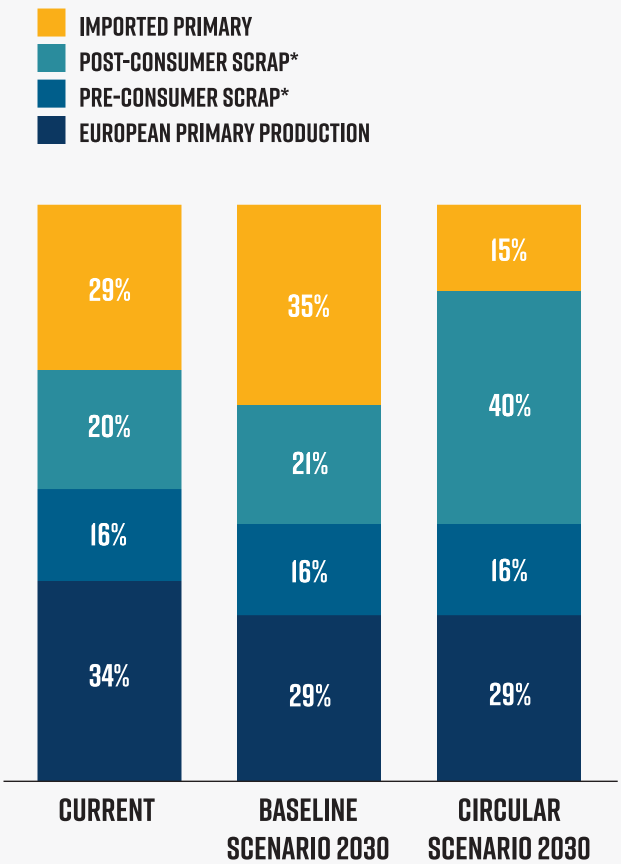
CASE STUDY: ALUMINIUM RECYCLING

**ALUMINIUM SCRAP VOLUMES ARE EXPECTED TO INCREASE**
Mt ALUMINIUM SCRAP, 2020 AND 2030




*As the aluminium stock increases, more scrap will be available for recycling over the next 10 years*

**POTENTIAL TO INCREASE THE RECYCLING RATE TO DECREASE THE DEPENDENCY ON IMPORT**
METAL SUPPLY - Mt ALUMINIUM BY SOURCE




*With the right equipment and competence in place, Europe can meet up to 85% of demand with domestic production compared to 65% in a baseline scenario*

**The EU aluminium market** has seen massive changes in the past decades. While some primary production remains, net imports have increased sharply, while a large share of EU production has ended. Chinese subsidised aluminium primary production has grown from a marginal share to close to 60% of the global market,[40] making it a major source of imports for semi-fabricated products in the EU and other regions. Another major trend is the growth in aluminium recycling. The EU has built up a significant stock of aluminium in its cars, buildings, electrical equipment, consumer products and more that is now becoming available. Modelling shows that the total amount of aluminium scrap is set to grow fast. In fact, by 2050, there could be enough to meet up to half of the rapidly growing demand.

**Europe thus faces a choice.** On the current course, there is a significant risk that scrap will be exported as a low-value raw material, while imports continue to rise because their cost does not reflect their environmental impact. Alternatively, the EU could use its own scrap, turning it into high-quality metal for continued benefit to the EU economy and to increase Europe's autonomy. Aluminium recycling could then become a major industrial opportunity, worth as much as EUR 12 billion per year by 2050, up from EUR 3 billion today.[41]

**This is a feasible scenario,** but it requires major changes in EU value chains and industry, as well as of the EU regulatory framework. There is a need to adapt upstream innovation and product design in order to facilitate the recycling process. Separate collection and dismantling practices in major value chains also have to improve, notably in the case of construction and automotive. Finally, by implementing new technologies, sorting that was impossible only a few years ago could now be achieved, making recycled aluminium useable for a much wider range of applications even as the traditional demand (cast aluminium in vehicles) is declining. Investments must take place in sorting technology to drive down the cost curve, and to enable the separation of different alloys of aluminium, as required for high-quality recycling and closed material loops. This provides a perfect example on how improved technology in the circular economy can allow the EU to capture new sources of value and industrial opportunity. The business case for investment in remelting capacity and aluminium refining must reflect the substantial industrial, resilience and environmental advantages of recycling over continued imports of high-carbon metal.

**NOTE:** *PRE-CONSUMER SCRAP IS METAL WHICH WAS NEVER USED IN A PRODUCT, INSTEAD IT WAS DISCARDED DURING THE PRODUCTION PHASE AND SENT BACK FOR REMELTING. POST-CONSUMER SCRAP COMPRISES METAL WHICH HAS BEEN IN A PRODUCT THAT HAS REACHED ITS END OF LIFE.

**SOURCE:** MATERIAL ECONOMICS (2018), THE CIRCULAR ECONOMY – A POWERFUL FORCE FOR CLIMATE MITIGATION.[42] AND EUROPEAN ALUMINIUM (2020), CIRCULAR ALUMINIUM ACTION PLAN.[43]

## CONTRIBUTION TO SOCIAL OBJECTIVES AND LOCAL JOB OPPORTUNITIES

**Unemployment is becoming** a major concern in the wake of COVID-19, with sharp drops in employment across major economies. Policy-makers are understandably asking how to quickly restore higher employment levels as part of a recovery.

Circular economy opportunities can offer one piece of this puzzle. Circular business models typically shift resource use from high dependence on imports to more local inputs. In addition, while the transition could negatively affect employment in some sectors (e.g., raw materials production or some parts of manufacturing), overall, many circular economy operating models are more labour-intensive than their "linear" counterparts. For example, recycling and remanufacturing require more complex processes of reverse logistics, sorting and reprocessing. By one estimate, an additional 36 jobs are created for every 10 000 tonnes of resources that are recycled instead of incinerated.[44] Adding up a broad range of measures, one study for the European Commission estimated that a transition to a circular economy could increase net employment by 650 000–700 000 jobs by 2030.[45]

Such increases in employment are a key building block for social inclusion and equality. Along with adding jobs, a transition to a more circular economy would reduce costs in major value chains such as mobility, housing and food (see Section 2.1). Lowering the cost of these essential services would make them more accessible, further supporting social equality across the EU.

## CUTTING GHG EMISSIONS FROM EU MATERIALS USE BY MORE THAN HALF

A more circular economy also interacts strongly with the target to reduce GHG emissions. Around 45% of total $CO_2$ emissions in the EU can be traced back to the production of the cars, food, clothes and other products that we use on a daily basis. Around half of these can be traced to industrial emissions to produce materials (the rest is attributed to agriculture, forestry and other land uses).[46]

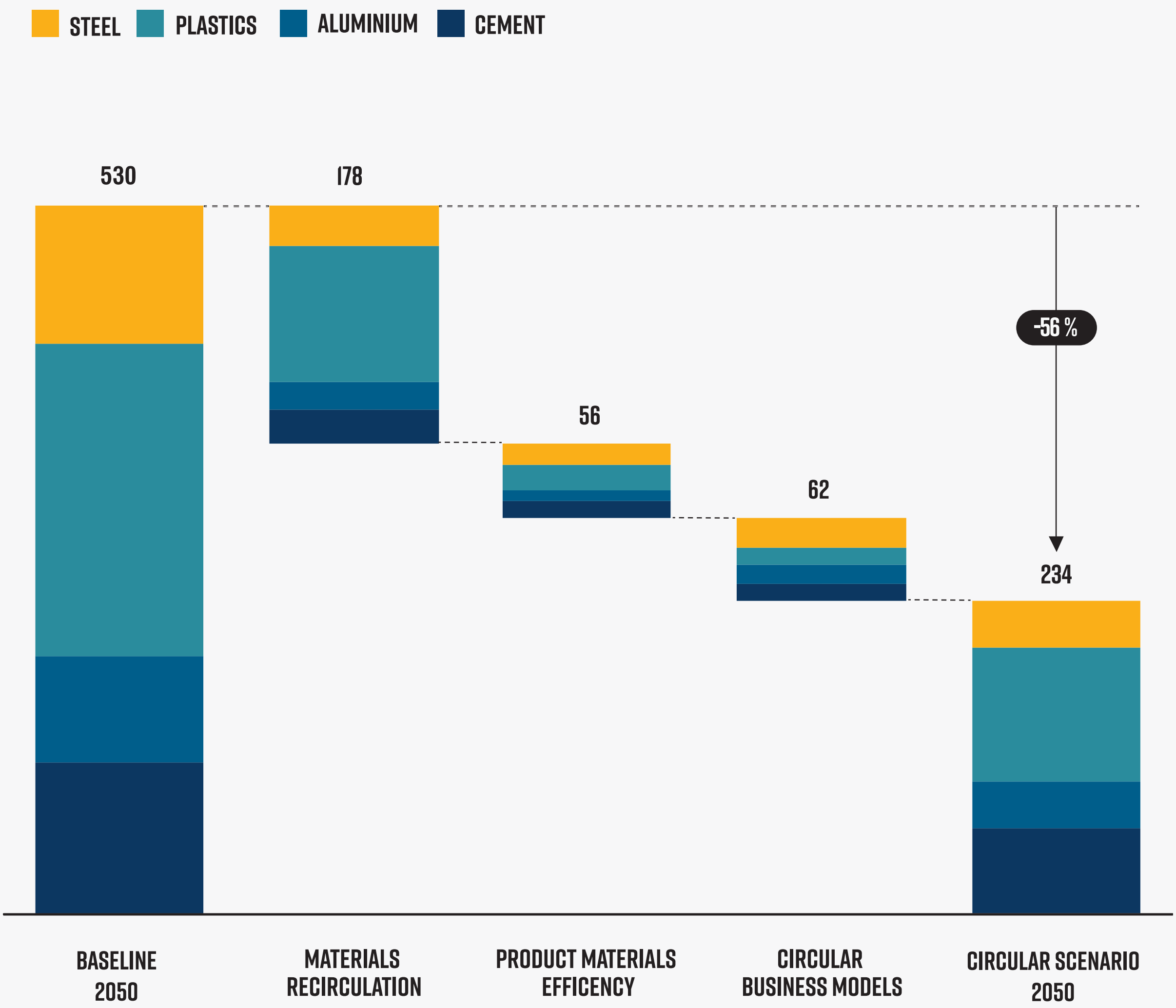
Specifically, as much as two thirds of industrial $CO_2$ emissions are linked to the production and use of energy-intensive materials such as plastics, steel, aluminium or cement.[47] These emissions are a conundrum for EU climate targets: the technologies required for zero-carbon production are not yet in use, are often costlier than today's industrial processes, and require very large investments as well as large amounts of zero-carbon electricity to be viable.[48]

The circular economy offers a complementary route to cutting these emissions. Much like energy efficiency is a key part of reducing the emissions from energy production, improving the use and reuse of major materials can cut industrials emissions substantially. In fact, these emissions could be cut by more than 50%, reducing EU $CO_2$ emissions nearly 300 million tonnes $CO_2$ per year by mid-century, as shown in Exhibit 10. Conversely, without circular economy measures, meeting the EU's climate targets will be more expensive.

*Exhibit 10*

# A MORE CIRCULAR ECONOMY COULD REDUCE EU GHG EMISSIONS BY AS MUCH AS 296 Mt $CO_2$ BY 2050

**EU EMISSIONS REDUCTIONS POTENTIAL FROM A MORE CIRCULAR ECONOMY, 2050**
MILLION TONNES OF $CO_2$ PER YEAR




**SOURCE:** MATERIAL ECONOMICS (2018), THE CIRCULAR ECONOMY – A POWERFUL FORCE FOR CLIMATE MITIGATION.[49]

# 3. THE CIRCULAR ECONOMY AND THE EU'S COVID-19 RECOVERY

**Our analysis shows that** the circular economy holds significant long-term potential for the EU economy – and it fits well with EU leaders' priorities for the COVID-19 recovery. This raises two key questions: How do circular economy measures fit with the EU's near-term economic stimulus plans? And to what extent has the COVID-19 crisis itself affected the circular economy transition?

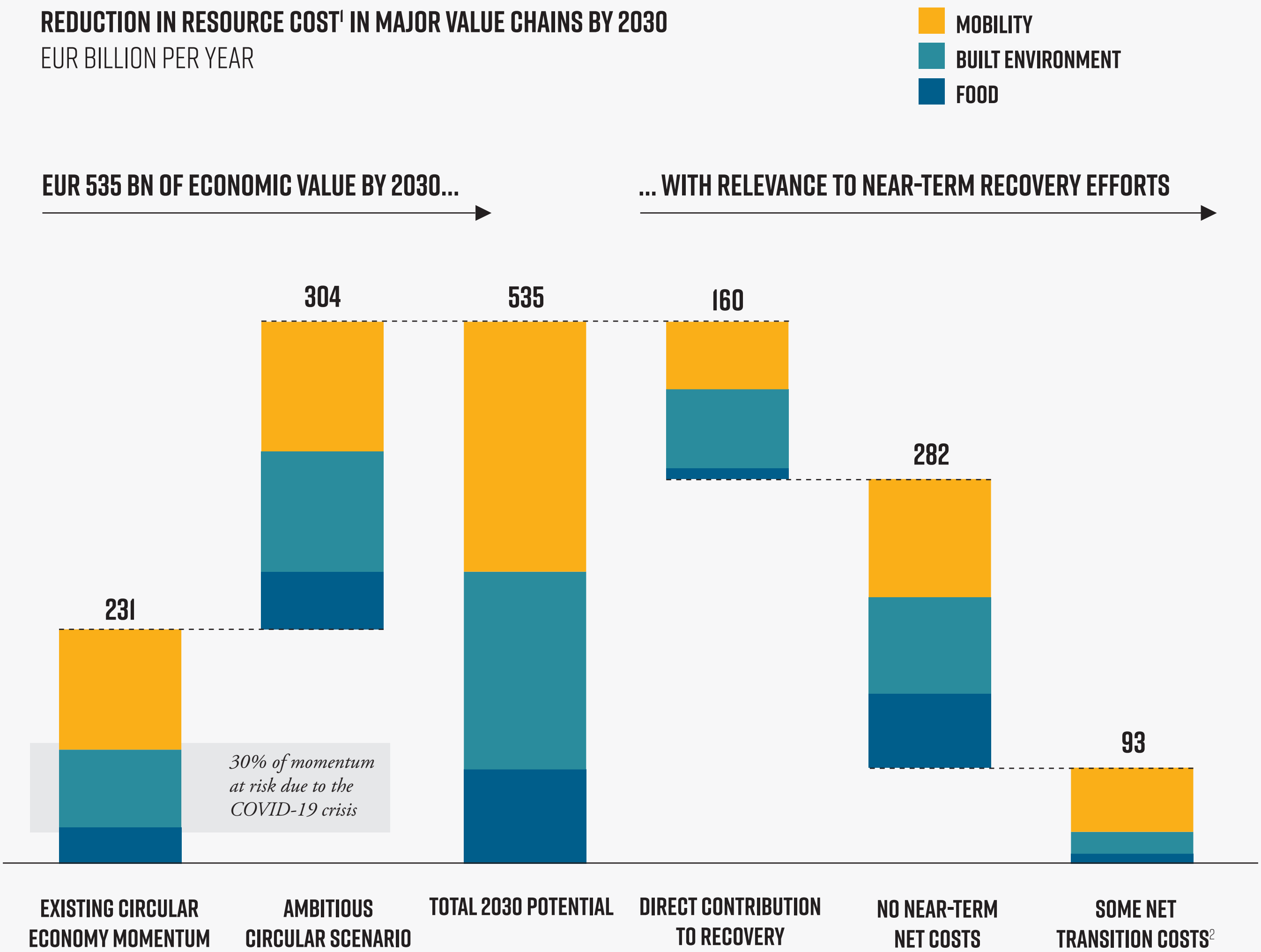
**We found that much** of the circular economy agenda still is highly relevant (see Exhibit 11). Of the total 2030 potential benefits of EUR 535 billion per year discussed in Section 2.2, roughly EUR 160 billion (30%) would come from actions that could also stimulate the economy in the near term and form part of recovery efforts. Moreover, achieving much of the remaining long-term value requires little or no increase in near-term costs, and could continue to advance even with the crisis.

**The analysis shows** some cause for some concern, however. Volatility in input markets, reduced investment, challenges to near-term business solvency, and increased uncertainty all hit new, small-scale and innovative economic activity especially hard – making some circular economy business models especially vulnerable. Policy-makers thus have an important task ahead to handle this problem. If not, a loss of momentum could jeopardise as much as 30% of the value that the EU was poised to capture by 2030 before the pandemic changed the landscape.[50]

*A major share of the circular economy transition can be driven by near-term actions that also contribute to economic recovery.*

*Exhibit 11*

# A LARGE SHARE OF THE CIRCULAR ECONOMIC OPPORTUNITY HAS A CLOSE FIT WITH EU RESCUE AND RECOVERY EFFORTS




**EXISTING CIRCULAR ECONOMY MOMENTUM**
*(pre-COVID-19) updates the Current trends scenario first defined in Growth Within (2015), reflecting improvements to 2030 through technology breakthroughs and current trends, where the current system is optimised without making real system-level changes.*

**AMBITIOUS CIRCULAR ECONOMY SCENARIO**
*is also based on the modelling of Growth Within (2015), showing the results of a redesign of current systems towards circular principles. The analysis has been updated to consider developments following the publication of the report.*

**NOTES:** [1]RESOURCE COST REFERS TO THE TOTAL COSTS OF ECONOMIC ELEMENTS OR INPUTS USED TO PERFORM ACTIVITIES, INCLUDING LABOUR COST, COST OF MATERIALS, SUPPLIES, EQUIPMENT, TECHNOLOGIES, ETC. THIS THUS INCLUDES BOTH OPERATIONAL AND CAPITAL COSTS. [2]POTENTIAL CALCULATED BASED ON MEASURES WITH NET NEAR TERM COSTS. THE SHARE OF THE POTENTIAL WITH SUCH NET COSTS IS ESTIMATED AT 10% OF THE POTENTIAL WHEN EXTERNALITIES ARE ACCOUNTED FOR, BUT CLOSER TO 25% IF THESE ARE IGNORED. THE NUMBER GIVEN IN THE FIGURE IS AN AVERAGE OF THESE TWO.

**SOURCE:** MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM ELLEN MACARTHUR FOUNDATION (2015)[51] BY THE SUN FOUNDATION.[52]

## 3.1 COVID-19 POSES SERIOUS RISKS TO THE CIRCULAR ECONOMY TRANSITION

**The last several years** have seen significant movements towards more circular business models and systems. Many companies are working towards ambitious circular economy targets. The EU and its Member States adopted the first Circular Economy Action Plan in 2015, updated in 2020 to create a framework for several longstanding policy areas and extending ambition. This, in turn, has generated significant activity, ranging from the gradual expansion of recycling infrastructure and activities, to a wealth of company initiatives based on new business models, often driven by SMEs and start-ups. We estimate that those trends had put the EU on a path to realising value of EUR 231 billion per year by 2030.[53] However, the COVID-19 crisis could significantly slow the momentum.

The pandemic has raised five main challenges:

### SHORT-TERM MARKET SHOCKS AND VALUE CHAIN DISRUPTIONS

The crisis has caused immediate, near-term disruption in many supply chains – and circular business models are no exception. For instance, collection rates and inter-regional flows of end-of-life materials have been disrupted. Such short-term adjustments pose great challenges to recycling companies that depend on a continuous inflow of scrap. Demand has also declined for some market segments, such as aluminium recycling geared to the automotive industry.

### FALLING RAW MATERIALS PRICES

2020 has seen a sharp drop in commodity prices – most notably oil, which has dropped by almost 35% since the beginning of 2020 (as of September)[54], resulting in much lower naphtha prices (the key input to plastics production). Other commodities, e.g. across metals, ores, wood pulp and other materials, have also been affected. European companies are worried about a coming period of over-capacity in markets for steel, aluminium, plastics, etc. – perhaps exacerbated by recovery packages put in place around the world. Such over-supply would further depress prices, and the impact of these trends would undermine the business case for the circular economy. Many circular economy businesses already faced an uphill battle against established, resource-intensive alternatives, not least as the latter benefit from prices that do not reflect the full environmental costs of commodities. Most primary aluminium imports into Europe, for instance, carry unpriced carbon costs (on the order of up to EUR 2000 per tonne)[55] that alone are greater than the cost of aluminium itself (around EUR 1500 per tonne as of September 2020).[56] Recycled plastics face similar challenges, as shown in Exhibit 12.

*Exhibit 12*

# FALLING PRICES OF VIRGIN RAW MATERIALS MAKE RECYCLED MATERIALS LESS ATTRACTIVE

CASE STUDY: PLASTIC RECYCLING

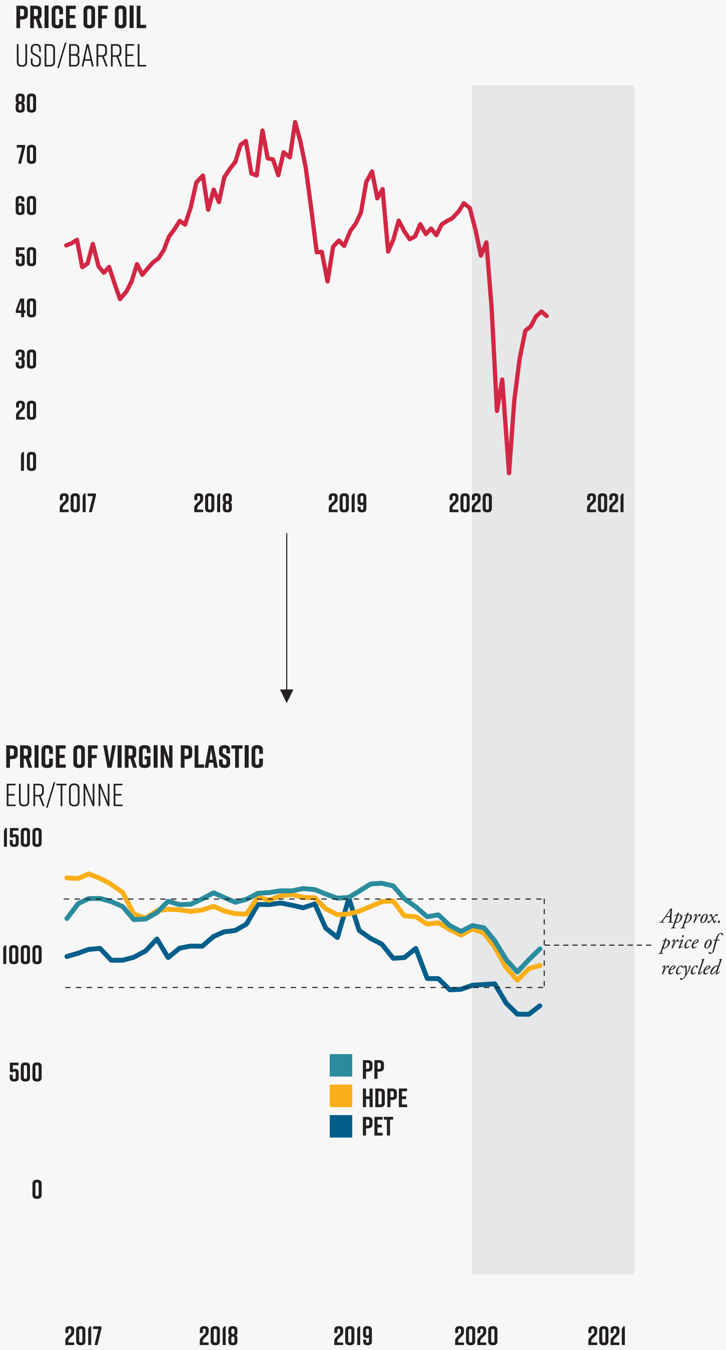
**The EU has set ambitious** recycling targets – for example, that 50% of all plastic packaging should be recycled by 2025.[57] Increasing the recycling rate has multiple benefits: recovering material value that is otherwise lost, reducing $CO_2$ emissions and boosting local jobs. The EU estimates that the plastic recycling industry could employ an additional 200 000 people by 2030 (compared to 2015)[58], and by making reuse and recycling the standard for end-of-life plastics, a reduction of ~120 million tonnes of $CO_2$ (50%) could be achieved in 2050.[59] In the longer term, there is no feasible way for plastics to fit into an economy with net zero emissions of GHGs without turning the majority of end-of-life flows into raw materials for new production.[60]

**However, the actual amount** of plastics recycled is far lower than it could be. Despite a long history of targets, less than 10% of EU demand for plastics is served by recycling (2015).[61] The need for change has already been recognised, and recent policy initiatives will both reform how recycling is measured and introduce new support measures. For example, the Circular Economy Action Plan proposed mandatory requirements for recycled content and waste reduction measures for crucial products such as packaging, construction materials and vehicles.

**Nonetheless, our analysis** suggests that stronger market signals are needed. Companies are on the cusp of developing technologies that could provide high-quality recycled plastics truly capable of replacing virgin plastics. However, both advanced mechanical and chemical recycling face a cost gap that must be overcome. The COVID crisis has exacerbated this, as the oil prices fell by ~40% between January and June,[62] resulting in a lower price of virgin plastics. Virgin plastic prices are also set in worldwide markets that do not price $CO_2$.This creates a major challenge for recyclers and worsens the business case for additional investments.

**The EU therefore faces a dilemma:** on the one hand, a clear long-term target and convincing set of benefits from building a substantial secondary plastics industry; on the other hand, an operating environment where primary plastics are more competitive than ever as their full cost is not reflected. Many in the recycling industry are convinced that recycled plastics can compete in the long run, but current circumstances militate against the investments needed to make this possible. If they wish to close the gap, policy-makers must intervene to level the playing field, or risk that the combination of falling investment, depressed raw materials prices, and lack of concrete policies will stall development.

**In the long run,** closing the recycling gap depends on there being a fundamental business case, not just on targets for recycling activity. This requires attention to the full value chain, as the cost and feasibility of producing high-quality secondary plastics depends strongly on the design of products, and on the collection systems for end-of-life products. Policy could help by ensuring there is sufficient demand for recycled content, in line with environmental and other objectives. Recycling thus is one of many areas where multiple policy approaches are needed, and where a balanced product policy agenda can play an important role.




**SOURCE:** GRAPH BASED ON DATA FROM PLASTICPORTAL.EU[63] AND ICIS,[64] PRICES ARE BETWEEN 2017-01-01 UNTIL 2020-07-01.

## FALLING INVESTMENT IN CRITICAL INFRASTRUCTURE AND TECHNOLOGY

Investment levels in European economies have fallen, by 11% in the second quarter,[65] and were predicted to fall by 24% in the Eurozone in 2020.[66] This, too, risks slowing the circularity transition, which requires significant investments in new logistics solutions, circular product redesign and new manufacturing methods, to name a few. Delayed commitment to research and development, technology adoption and new infrastructure would risk delaying the overall transition and opportunities for additional value.

## LIQUIDITY PROBLEMS AND INSOLVENCY RISK, RESULTING IN LOST HUMAN AND INSTITUTIONAL CAPITAL

Much of the circular economy transition is being led by companies seeking entirely new ways to deliver goods and services. These often are SMEs and start-ups that depend on local supply chains and business environments. The COVID-19 crisis poses a serious threat, as small companies cannot survive long when revenue is lost. Much is at stake here, as a wave of bankruptcies would entail loss of human and institutional capital that could take many years to recreate.

## REDUCED CAPACITY RISKS FURTHER LOCK-IN TO LEGACY SYSTEMS

The circular transition often has transition costs: an initial period of additional outlays, risk-taking, reallocation of resources, retraining, investment volumes, build-up of capacity, etc. Economic downturns can be periods of "shake-out", where old approaches are more rapidly abandoned in favour of new ones. However, there is also a risk that reduced risk appetite and institutional capacity instead throttle the pace of change. At worst, this could result in further lock-in to legacy, linear systems. This effect is especially prominent in the case of long-lived infrastructure.

These risks could jointly translate to a wide-ranging challenge to the emerging circular transition (see Exhibit 13). There is great uncertainty about how things will play out – both the duration of the disruption and the depth of damage and delay that it will cause. For instance, if these risks caused a three-year delay in the most vulnerable activities, as much as EUR 50-70 billion of the 2030 potential could be forgone.[67] This value would only include the risk of delaying the circular transition as investments are put off or as companies either fold or abandon emerging circular economy initiatives. At worst, losses would extend not just to lost momentum, but to the undoing of some circular economy progress that has already been achieved, with the direct loss of businesses as a result.

*Exhibit 13*

# WHAT ASPECTS OF THE CIRCULAR ECONOMY TRANSITION ARE AT RISK DUE TO COVID-19?

| KEY RISKS | EXAMPLES | |
|---|---|---|
| SHORT-TERM MARKET SHOCKS | • *Aluminium recycling*<br>• *Car-sharing services* | *Short-term decline in demand for certain services or products causing financial challenges and potential delayed deployment. For example the aluminium recycling business experiencing lower demand from the automotive industry or car-sharing services experiencing lower demand due to social distancing and less travelling.* |
| FALLING RAW MATERIALS PRICES CHALLENGE CIRCULAR BUSINESS MODELS | • *Plastics recycling*<br>• *Aluminium recycling* | *Drop in commodity prices and overcapacity risks undermining the business case for recycled materials* |
| FALLING INVESTMENT IN CRITICAL INFRASTRUCTURE AND TECHNOLOGY COULD DELAY THE TRANSITION | • *Chemical recycling of plastics*<br>• *Textile recycling* | *Risks that the development of critical innovation slows down, as well as uptake of new technologies* |
| BANKRUPTCY RISKS AND POTENTIAL LOSS OF HUMAN AND INSTITUTIONAL CAPITAL | • *Repairs*<br>• *Sharing of durable goods*<br>• *Advanced analytics for precision agriculture* | *Start-ups/SMEs that are dependent on continued revenue streams risks bankruptcy if not getting financial support* |
| REDUCED CAPACITY RISKS FURTHER LOCK-IN TO LEGACY SYSTEMS | • *Green and blue infrastructure*<br>• *Regenerative agricultural practices* | *Reduced appetite for change risks further lock-in to linear systems, or risk of delayed transition due to high transition costs* |

*Exhibit 14*

## GOOD STIMULUS NEEDS TO BE 'TIMELY, TARGETED, AND TEMPORARY'[68]

**TIMELY** *means that the stimulus must be decided on and then carried out while the economic mechanisms it seeks to address are still relevant. This can be difficult: for example, large-scale infrastructure projects can take a long time to get off the ground. In an ordinary recession, from which the economy rapidly recovers, it can mean that the stimulus arrives too late.*

**TARGETED** *means it must be able to address the specific economic factors that stand in the way of economic recovery. One major mechanism for this is to mobilise economic resources that otherwise would be left idle, thus preventing the economy from operating at its full capacity. The other major mechanism is to prevent the destruction of human and institutional capital – not least, the bankruptcy of otherwise sound firms or withdrawal of workers from the labour market – that reduces the total capacity of the economy. The latter, in particular can have very long-lasting damaging effects.*

**TEMPORARY** *means it should be possible to scale back stimulus action when it is no longer needed, avoiding long commitments to expenditures once the economic benefits are smaller.*

## 3.2 ALIGNING THE CIRCULAR ECONOMY WITH THE 2020 ECONOMIC STIMULUS AGENDA

**The EU and its Member States** are firmly committed to policy actions to stimulate the economy. The Next Generation EU recovery fund amounts to an unprecedented EUR 750 billion, including the EU Recovery and Resilience Facility, which is to provide EUR 672.5 billion in grants and loans to member states.[69] Member States will be free to decide what to include in their individual recovery and resilience plans, but to receive funding, they must address priorities identified by the EU, in particular those related to green and digital transitions.

**The stimulus provided** will need to clear a high bar, addressing many competing needs. Policy-makers also face the challenge of finding stimulus actions that meet the criteria of being "timely, targeted, and temporary" (see Exhibit 14).

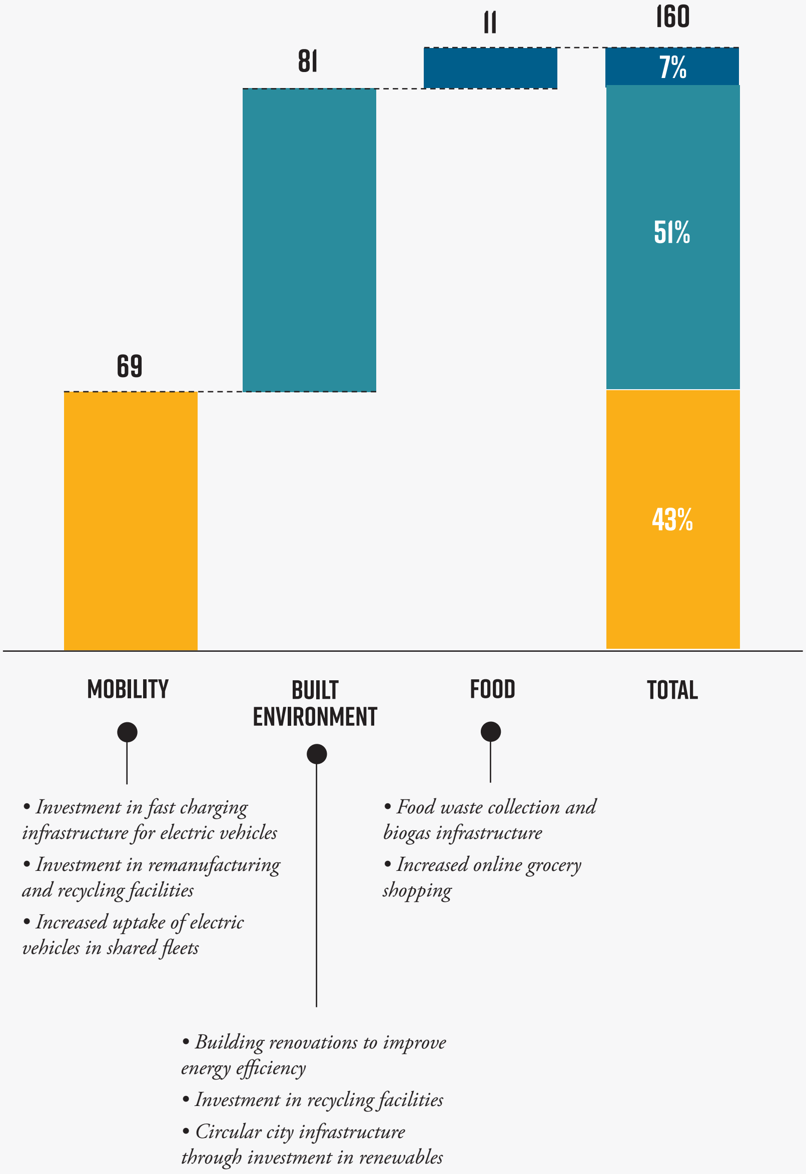
**There is a simultaneous** commitment to maximise the benefits of stimulus spending, and EU leaders have expressed a strong commitment to ensuring that the recovery aids other overall aims, including the attainment of EU climate targets.

**Even with this high bar,** we find that there is significant potential for the circular economy to be part of stimulus programmes and directly contribute to the recovery. Stimulus action taken as part of the recovery programmes could enable circular business models that by 2030 bring cost savings of EUR 160 billion (see Exhibit 15). This corresponds to approximately one-third of the total circular potential.

*Exhibit 15*

# WIN-WIN OPPORTUNITIES FOR RECOVERY AND THE CIRCULAR ECONOMY TRANSITION CAN CONTRIBUTE SAVINGS OF EUR 160 BILLION BY 2030 AND ARE FOUND ACROSS ALL SECTORS OF THE ECONOMY

**STIMULUS ACTIONS CAN HELP UNLOCK SAVINGS FROM A MORE CIRCULAR ECONOMY**
EUR BILLION PER YEAR, 2030




**NOTE:** MORE DETAILS ON THE METHODOLOGY AND ASSESSMENT OF ACTIONS CAN BE FOUND IN THE APPENDIX.

**SOURCE:** MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM ELLEN MACARTHUR FOUNDATION (2015)[70] AND THE SUN FOUNDATION.[71]

**Much of this potential arises** through the potential for investment to enable a more circular economy. Done right, there are substantial investment opportunities that can stimulate additional economic activity for the recovery; deliver financial savings with either private payback periods of 3–6 years or high public benefit-cost ratios; and prevent lock-in to linear systems that ultimately make it more difficult down the line to meet societal objectives (e.g. climate targets). Examples of such investments are found across the major value chains (see Exhibit 16).

*Exhibit 16*

## THE INVESTMENT OPPORTUNITY OF A CIRCULAR TRANSITION OFFERS A WIDE VARIETY OF RECOVERY EFFORTS

| SECTOR | EXAMPLES OF AREAS OF INVESTMENT OPPORTUNITIES | SIZE OF INVESTMENTS |
|---|---|---|
| MOBILITY | *Fast charging infrastructure for electric vehicles*<br>*• 1 million new charging stations across Europe* | EUR 12 BN |
| | *Roll out remanufacturing of car parts*<br>*• EUR 10 billion market growth estimated by 2025* | EUR 1 BN |
| | *Increased uptake of electric vehicles*<br>*• 1.6 million new electric vehicles in shared fleet* | EUR 40 BN |
| BUILT ENVIRONMENT | *Investment in recycling facilities*<br>*• 20 million tonnes of building materials re-used* | EUR 2 BN |
| | *Green urban development*<br>*• 30 cities adopting and investing in green urban development* | EUR 20 BN |
| FOOD | *Biogas infrastructure*<br>*• 45 million tonnes of waste processed through anaerobic digestion and biorefining cities adopting and investing in green urban planning* | EUR 10 BN |

**SOURCE:** ELLEN MACARTHUR FOUNDATION (2017), ACHIEVING GROWTH WITHIN.[72]

*There is significant potential for the circular economy to be part of stimulus programmes and directly contribute to the recovery.*

*Exhibit 17*

# INVESTING IN THE RIGHT THINGS NOW CAN GENERATE SIGNIFICANT BENEFITS FOR MANY DECADES TO COME

CASE STUDY: BLUE- AND GREEN INFRASTRUCTURE

**BIOSWALES FOR THE INFILTRATION**
OF PRECIPITATION ON SITE

**GREEN OR VEGETATED ROOFS**
TO MITIGATE URBAN HEAT ISLANDS AND IMPROVE AIR QUALITY

**RESTORATION AND INTEGRATION**
OF NATURAL HABITATS FOR IMPROVED BIODIVERSITY AND COMMUNITY LIVEABILITY

**By 2030, 573 million or 78%**[73] of Europe's residents will live in cities. That, in combination with more extreme weather, will put pressure on existing infrastructure. Blue and green infrastructure (BGI), such as building green roofs, planting trees in urban areas and establishing urban wetlands, provides a less invasive alternative to reduce stress on pre-existing structures. By choosing blue and green infrastructure (over "grey" – e.g. expanded concrete sewer systems), results from conducted projects show that there is a potential for cities to reduce short-term infrastructure costs for larger projects by up 40%[74] while simultaneously reducing long-term energy[75] and water treatment[76] costs considerably. For example, each street tree planted in Berkeley, California, reduces annual city energy costs by USD 15.[77]

**Putting this in the context** of the EU, replacing 50% of investments in grey drinking and wastewater infrastructure with BGI could unlock annual savings of up to EUR ~20 billion in short-term infrastructure costs.[78] Additionally, BGI is effective in managing precipitation-induced flooding, infiltrating up to 100% of stormwater during extreme weather events.[79] It can also help mitigating urban heat islands by lowering the city temperature by up to 5°C,[80] depending on the city's location and the scale of BGI development. Madrid, where the share of days with abnormally high temperatures will reach 20% by 2050, was able to reduce temperatures in certain areas using BGI by 4.5°C.[81] Other benefits include improved air quality,[82] groundwater level balance and community liveability.[83]

**A potential issue** with some types of BGI, however, is that actors other than the developer receive a large share of the benefits. The benefits of green roofs and vegetated walls, for instance, accrue to the owners of the surrounding buildings as their value increases, to the city through reduced stormwater runoff, and to society through lower city temperatures and a generally nicer environment. Financing such BGI might therefore prove difficult and will require innovative financing solutions.

**The development of BGI** also has a positive short-term economic impact. It requires labour, which can help mobilise idle resources in the economy, and the benefits can often be realised directly. Given the potential stimulus effects, BGI projects should be considered and included in national recovery and resilience plans. BGI can and should also be deployed in combination with traditional infrastructure projects, as it enhances their value.

**Additionally, BGI exemplifies** potential lock-in effects of not investing in circular economy measures today. If mainly "grey" infrastructure is built, cities could be left with suboptimal and less cost-efficient structures, and the benefits of BGI would not be gained for a long time. Lastly, BGI significantly improves urban resilience to the effects of climate change, whether water- or heat related, something cities can benefit from immediately.

**While investments make up** the lion's share of opportunity for near-term stimulus via circular economy measures, there are other areas to consider as well. In particular, some measures can help free up resources for other uses, boosting near-term productivity. Examples include:

- **Reduced food waste,** where rapid adoption of best practices, in principle, would save large amounts on household expenditure, against very modest costs. The potential is dampened by the often-slow pace of change of such chiefly behavioural measures.

- **Telecommuting,** which has risen fast during the COVID-19 pandemic, resulting in significant savings on transportation costs.

- **Lower energy expenditure in buildings,** which can accumulate at the pace that it is feasible to accelerate the pace of building renovation.

- **Online grocery shopping,** which offers opportunities for lower transport costs and savings on labour/leisure time.

- **Repair of electronics,** lowering the total cost for electronics for households and increasing the capacity to spend in other areas (see Exhibit 18).

**The stimulus potential** of these vary significantly. Most will take time to develop, so the cost savings have only limited potential within 1–2 years. However, within a 5-year horizon, the potential starts to be significant, which earns some of these opportunities a place within overall recovery efforts.

*Exhibit 18*

# INCREASED RATES OF ELECTRONICS REPAIR CAN GENERATE A SIGNIFICANT NUMBER OF NET LOCAL JOBS WHILE SHARPLY REDUCING $CO_2$ EMISSIONS

CASE STUDY: REPAIRING ELECTRONIC EQUIPMENT

**The actual lifetime of smartphones,** televisions, washing machines and vacuum cleaners is, on average, 30% shorter than their designed lifetime. For example, most smartphones are used for less than 22 months.[84] In a customer survey, roughly half of respondents said their main reason for not repairing a faulty product, was that repair was too expensive, or they did not know where or how to repair.[85]

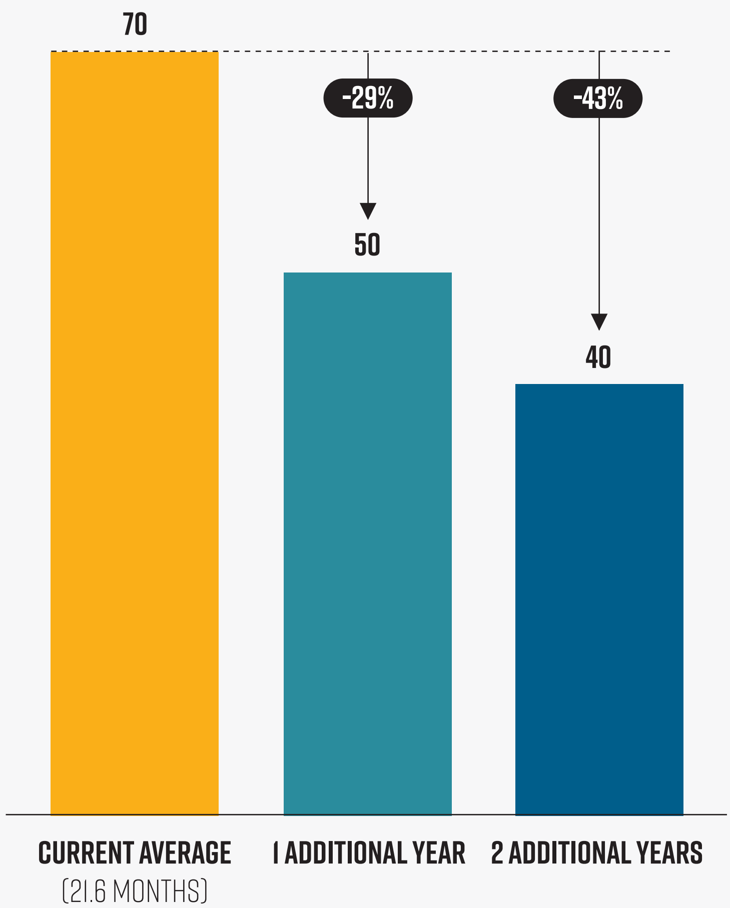
**Increasing repair levels** would enable more local jobs, while also lowering ownership costs for consumers. Another estimate shows that if additional 50% of current e-waste were repaired or refurbished instead of being wasted, over 1 million jobs could be created in Europe,[86] though more research is needed on this. Such jobs are especially valuable at a time where many blue-collar jobs have moved abroad and it could contribute to boost local employment in deprived regions.[87] Further, by extending the lifetime by one year for all washing machines, notebooks, vacuum cleaners and smartphones, 4 million tonnes of $CO_2$ emissions could be saved annually in Europe by 2030.[88] Further, electronics require supply from many critical raw materials whose demand may grow significantly with increased digitalisation and electrification. Handling these critical raw materials efficiently (e.g. through reuse, repair and recycling) can reduce exposure to future supply uncertainties.

**Considering how consumers** find it expensive to have electronics repaired or lack information about where it can be done, efforts should be focused on providing economic and fiscal incentives to repair the devices, review regulatory enablers for making it easier with third-party repair, and provide more information on available repair services. There would be two significant near-term economic benefits: First, increased demand for repairs would create jobs and mobilise unutilised resources. Second, a higher degree of repairing can lower the total cost of ownership for consumers and free up resources for other economic use. Establishing an electronics right to repair is also an important measure that is set to become reality in the EU in 2021.[89]

**To really capture** the longer-term potential for repair, products need to be designed with this in mind in the first place. Assuring that devices are made to last, repaired and reused, and that firmware and software supporting their use are required for longer term compatibility without performances loss, would significantly facilitate a circular electronics market. The EC's Circular Economy Action Plan highlights electronics (as well as other energy products) and suggests regulatory measures to ensure that mobiles phones, tablets and laptops are designed for durability, reparability, upgradability, maintenance, reuse and recycling. Such continent-wide actions force manufacturers to take action, and can enhance European resilience by creating more local jobs and reducing pressure on strategic natural resources.

**OVER A 10-YEAR PERIOD, $CO_2$ EMISSIONS FROM MOBILE PHONES SOLD AND USED IN THE EU CAN BE REDUCED BY 43% IF THE AVERAGE LIFETIME IS INCREASED BY 2 YEARS**

MILLION TONNES $CO_2$, CUMULATIVE OVER 10 YEARS




**SOURCE:** EUROPEAN ECONOMIC AND SOCIAL COMMISSION (2019).[90]

## 3.3 CONTINUING THE PURSUIT OF LONG-TERM VALUE AT A TIME OF CRISIS

**In the preceding section,** we identified the circular economy levers that are either at risk from the current crisis, or can be incorporated in stimulus programmes. However, much of the circular economy opportunity is a more long-term story: a set of business opportunities and systems changes that are often at an early stage, but nonetheless with a proven potential. This could involve, for example, technologies that require further development, such as textile recycling (see Exhibit 20). Prior to the crisis, EU policy-makers and businesses had already embraced large parts of this agenda. The question now is how the COVID-19 crisis might change this.

**We systematically analysed** four potential ways that a trade-off could arise between capturing the long-term potential in the ambitious 2030 scenario, and pursuing economic recovery in the near term:

**The role of externalities in the economic case:** Some circular business models are not financially attractive in the near term for an individual company, but they are highly beneficial to society. For example, by some measures, the total externalities imposed by reliance on personal vehicles are on the same order of magnitude as the total resource cost of mobility (see Exhibit 19), so just looking at financial costs gives a very skewed picture. Similarly, imported aluminium[91] can carry a $CO_2$ footprint of as much as 20 tonnes $CO_2$ per tonne of aluminium. If this were priced at the level of up to EUR 100 per tonne $CO_2$,[92] the added cost (up to EUR 2000 per tonne) would again be similar to or higher then current market prices of the underlying commodity (around EUR 1500 per tonne of primary aluminium in September 2020).[93] These are particularly striking examples, but more modest, unpriced externalities arise in many other areas as well.

**The timing of costs and benefits:** Some circular economy measures that can be applied today have significant benefits that may take several years to materialise. This arises particularly when a change in design is the key to unlocking value during subsequent stages of a use cycle, such as increased opportunities for repair or reuse, longer lifetimes, or higher-value recycling. Our analysis shows many examples where changes to design in fact bring large net benefits in terms of total cost of ownership. However, there are cases where this value requires a larger initial outlay.

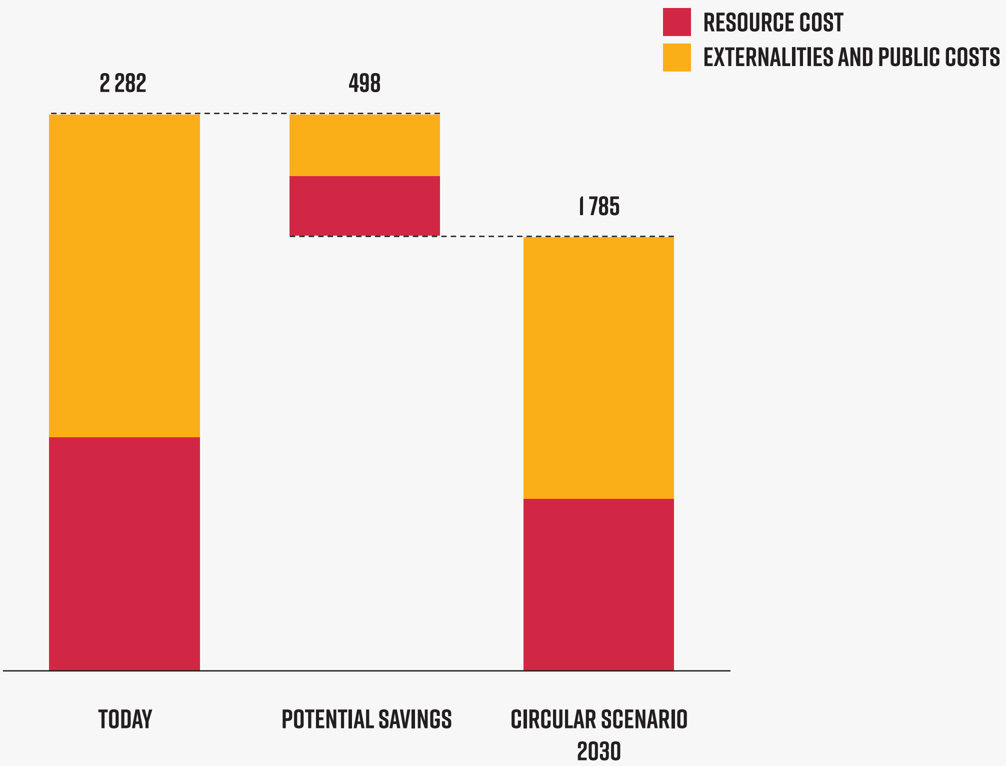
**Near-term vs. long-term net costs:** Other circular business models are expensive today, due to one-time transition costs (see Exhibit 21 for an example in agriculture), or the cost of emerging technologies, but adopting them now can unlock significant future cost savings. Measures taken today might help drive innovation and the scaling and diffusion of technologies; change consumer behaviour; or have other "spillover effects" that change the business landscape that jointly drive solutions down the learning curve and thus can make circular economy business models economically attractive in the future.

**The risk of unintended costs:** These can be regulatory, such as setting up new measurement systems, reporting requirements, infrastructures, etc., or unintended consequences of regulatory measures. They can also be transition costs, such as adjusting manufacturing facilities, developing new knowledge, creating new platforms, etc. These costs must be borne at some point in the circular transition, and, again, are often offset by future benefits (see Exhibit 22 for a discussion of these issues.)

*Exhibit 19*

# POTENTIAL REDUCTION IN EXTERNALITIES IS OF THE MAGNITUDE OF RESOURCE COST SAVINGS IN A CIRCULAR MOBILITY SCENARIO

**TOTAL COST FOR MOBILITY, 2020 VS. AN AMBITIOUS CIRCULAR SCENARIO 2030**
EUR BILLION PER YEAR, EU




**EXTERNALITIES AND PUBLIC COSTS REDUCED BY:**

- *Reduction of number of cars through higher occupancy and increased utilisation, resulting in lower $CO_2$ emissions and air pollution, reduced noise levels and less congestion*
- *Autonomous and connected cars are safer, more lightweight, reduce need for lanes and other infrastructure and can optimise traffic flows – thereby reducing $CO_2$ emissions, air pollution, congestion and number of accidents*
- *Electric vehicles reduce noise levels and have positive impact on $CO_2$ emissions and air quality, especially when shifting to renewable energy sources*

**SOURCE:** MATERIAL ECONOMICS ANALYSIS BASED ON DATA FROM ELLEN MACARTHUR FOUNDATION (2015)[94] AND THE SUN FOUNDATION.[95]

*Exhibit 20*

# LARGE UNTAPPED VALUE STREAMS OF TEXTILE WASTE – RECYCLING IS STILL IN EARLY DEVELOPMENT PHASE

## CASE STUDY: TEXTILE RECYCLING

**The fashion industry** value chain is a major source of GHG emissions – by some estimates as much as 2 billion tonnes of $CO_2$ equivalents per year, or 4% of the global total – and also results in significant water extraction, chemicals discharge, and (through indirect impacts) biodiversity loss.[96] Over 70% of GHG emissions are estimated to originate in upstream activities, especially in energy-intensive raw material production, preparation, and processing.[97] According to estimates by the European Commission, textiles ranks four amnong sectors in terms of pressure on primary raw materials, behind food, housing, and mobility.[98] Major change therefore is required to put the sector and its value chain on a course consistent with environmental objectives.

**The circular economy** constitutes one major opportunity to reduce these impacts. One vector for change is to increase the lifetimes of products, through recommerce, rental and refurbishment – strategies which jointly could double textiles' lifetimes. To create a fully circular fashion industry, however, textile recycling is also needed. A pilot high-value textile-to-textile recycling project for jeans showed that, compared with virgin fibre, recycled fibres can reduce water, energy and chemical consumption by 53%, 99% and 88%, respectively.[99] Another project (recycling uniforms) reduced GHG emissions by up to 33%.[100]

**While such proof-of-conept** is encouraging, circularity for textiles has a long way to go. Less than 1% of material from used clothes is recycled back to be made into new clothes.[101] A large share is not even collected – an estimate from 2015 was that only ~20% of textile waste in EU was separately collected and sorted.[102] There is thus a large untapped economic and environmental potential to make better use of end-of-life textile. From a recycling perspective, a major innovation push is required.

**The industry currently lacks** technology for economically viable recycling at scale, with the sorting and separation of fibres a particular challenge. Additionally, recycling requires clothes that are designed to have multiple life cycles, with high-quality fibres and less mixing of different types of fibre. Another way to increase the recycling rate of textiles is by improving tracking of materials. Blockchain-enabled solutions could be one way to store and share information among stakeholders along the value chain.

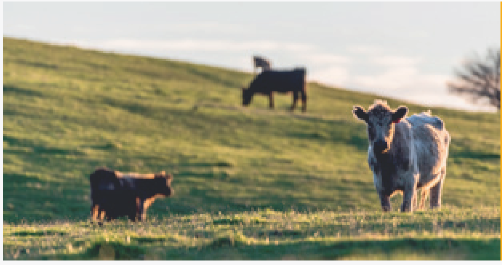
**The European Commission's** Circular Economy Action Plan recognises the importance of circular textiles. It proposes that, by 2025, all Member States should ensure separate collection of textile waste. R&D funding for recycling will be essential if these separate streams are to be put to good use. Collaboration and coordination will also be crucial to remove barriers and help fund large-scale projects.

*Less than 1% of used clothing is recycled back into new clothes.*

*Exhibit 21*

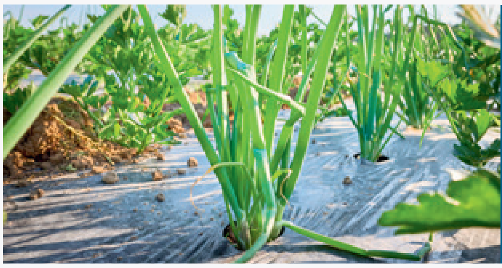
# A CHANGE IN AGRICULTURAL PRACTICES PROVIDES LONG-TERM BENEFITS, BUT THE SHORT-TERM COSTS ARE CONSIDERABLE

CASE STUDY: REGENERATIVE AGRICULTURE (SOMETIMES CALLED CONSERVATION AGRICULTURE)

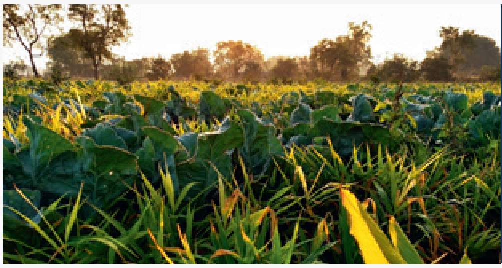


**HOLISTIC GRAZING**
SOIL REGENERATION THANKS TO MANURE

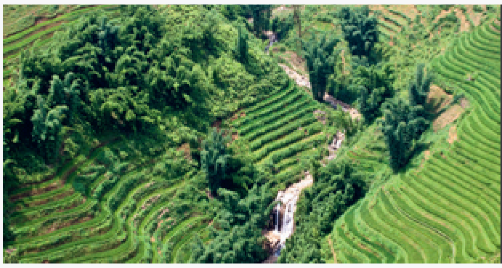
**KEY LINE LAND PREPARATION**
CULTIVATION ALONG CONTOUR LINES TO OPTIMISE WATER RETENTION



**ORGANIC AGRICULTURE**
CROP ROTATION, THE USE OF LESS CHEMICALS AND GMOS



**NO-TILL POLYCULTURE**
MIX OF DIFFERENT CROPS, COVER CROPS AND NO TILLAGE



**PERMACULTURE**
INTRODUCTION OF TREES, BUSHES AND SWALES

**NOTE:** REGENERATIVE AGRICULTURE AS DEFINED IN ACHIEVING GROWTH WITHIN (2017).[103]

**The success of modern agriculture** in feeding a rapidly growing world population is a major success of the last several decades. Nonetheless, agriculture is often cited as a major reason for loss of biodiversity and other pressures on ecosystems. For example, a report by the IPBES estimates that Europe has seen a 37% decline in wild bees and 31% in butterflies,[104] largely attributable to agricultural intensification and land use change. This is a complex area – as local declines can occur even without large-scale land use change (such as an estimated 76% decline of flying insects over 27 years in 63 protected areas in Germany).[105] Estimates also show that agriculture is the chief driver of 70% of global freshwater extraction,[106] while agriculture, forestry and other land use account for 24% of GHG emissions.[107] A major challenge is the depletion of natural capital, as 20% of the Earth's vegetated land has showed persistent degradation during the last 15 years.[108] In the EU alone, soil degradation results in yearly costs estimated at EUR 38 billion.[109]

**There are thus strong** reasons to seek new models of production that reduce these impacts while continuing to provide high-quality and low-cost food. Regenerative agriculture has been proposed as a major part of the solution. These span a wide range of farming management practices with focus on soil regeneration and health, improved water management, carbon sequestration, and greater diversity in crops. Important outcomes are reduced use of agrichemicals, which by some estimates could reduce input costs to farming by as much as 30%.[110] By diversifying the types of food grown, the resilience of both crops and farmers' incomes is improved. Increased crop resilience is consistent with the European Commission's emphasis on strategic autonomy for food. Regenerative agriculture also uses considerably less water, an important feature for an increasingly drought-stricken Europe, and it can improve soil carbon storage, aiding in climate change mitigation.

**The benefits are also difficult to quantify**, given the many externalities as well as some disagreement on relative productivity and scalability of practices. However, by some estimates regenerative agriculture could generate a lifetime yield of USD 2.3–3.5 trillion in operational cost savings[111] and by 2050, create 200 million additional full-time jobs.[112]

**Regenerative agriculture** can generate significant benefits, but in the short term, there are considerable transition costs. Crop yields may dip at first, and it can take up to 5–10 years for an individual farm to fully realise the economic benefits.[113] Conventional farming does not pay the cost of externalities, nor are ecosystems services (such as soil carbon sequestration) compensated.

**A successful adoption** of regenerative agriculture will therefore require concerted effort. For an ambitious scenario across the EU, an estimated EUR 15 billion of investment would be needed, in new equipment, machinery and related training, and to bridge transition costs.[114]

*Exhibit 22*

# UPSTREAM INNOVATION IS KEY TO SECURE A LARGE PART OF THE FUTURE POTENTIAL

## CASE STUDY: PRODUCT DESIGN REQUIREMENTS

**The viability of many circular economy** business models depends strongly on the way that products are initially designed. For example, design and materials choice determine whether a product can be repaired easily and by third parties, which in turn affects the lifetime of the product, the cost to the consumer, and job opportunities. It also influences whether the materials used can be easily recycled – and thus how profitable recycling will be and how much high-quality recycled material is available. For instance, only some 40% of the plastic packaging that enters recycling infrastructure today is actually recycled into new plastic.[115] Beyond these economic considerations, there also are important environmental aspects. By some estimates, as much as 80% of the sustainability performance of a product is determined by decisions at the design and manufacturing stages.[116]

**However, there are major barriers** to realising the potential that changed product design can hold. Companies designing products rarely are in a position to benefit from value that is unlocked only at later stages of the use cycle (potentially several years after a product is first sold) and by different actors. From the perspective of companies involved in circular economy business models of maintenance, repair, remanufacturing, reuse, recycling, etc., barriers caused by initial design choices are in turn a major externality: costs imposed by parties that do not in turn have incentives to take into account their situation. In terms of economics, this is a case of an "incomplete contracts" market failure: social value goes unrealised, as the two parties cannot find a market or contracting mechanism to jointly realise the potential for mutual gains.

**The product design requirements** in the Circular Economy Action Plan are intended to mitigate these issues, through mechanisms such as an expanded Ecodesign Directive, Ecolabels, or broad application of sustainability principles (such as increased durability or "right to repair") in other product regulations. As with other regulation, there are important trade-offs to consider: on the one hand, the undoubted value of easing coordination along the value chain; on the other hand, the risk that increased red tape or demanding regulation increases costs.


**40%**

**OF THE PLASTIC PACKAGING THAT ENTERS THE RECYCLING INFRASTRUCTURE TODAY IS ACTUALLY RECYCLED INTO NEW PLASTIC.**

**Considering the economic crisis,** timing becomes important. In some cases, the gains from changed product design come relatively rapidly, but in others the economic benefits are some way off (generally speaking, quicker for short-lived products such as plastic packaging and longer for cars or buildings). There also may be transition costs, such as the need retooling manufacturing lines, or higher up-front costs of circular solutions in construction. In other cases, the cost might be negligible – or it might be easy for companies that have already embraced circular business models, but not for their competitors who have not. Given that the product design plays such a vital role in unlocking the potential further down the value chain, the overall policy framework requires careful design (e.g., by providing support for transition costs).

**Setting the circular economy** levers against these considerations, we find that most of the available potential does not, in fact, pose near-term net costs and thus a trade-off with near-term recovery. We estimate that around 10–25% of the total 2030 potential in the Circular EU scenario involves measures of this type – the lower bound if environmental improvement and other co-benefits are considered, and the higher if less value is placed on these or if they are ignored. In other words, most of the circular economy potential instead has near-term costs broadly similar to today's solutions, or a cost gap that is bridged by environmental or other benefits, and with benefits that accrue relatively rapidly. This does not mean that policy-makers can ignore those measures, however, for two reasons.

**First, this territory** is far from safe in the current crisis. There are many examples where there is an emerging private sector financial case, but a range of factors – from economic uncertainty to regulatory barriers – may hold back investment and new business creation. Policy-makers therefore need to continue to put in place enablers, remove barriers, create lead markets, create long-term certainty, fund innovation and level the playing field where prices are distorted from their true social value.

**Second, there are cases** where aggregate costs are small, but individual companies nonetheless fear the transition costs – and their capacity to take them on is lower than ever with the current economic difficulties. Public support for the changes required, such as reconfiguration of production or the cost of new reporting systems or platforms, can be crucial to keep the momentum going.

# 4. AN AGENDA FOR ACTION: IMMEDIATE PRIORITIES FOR THE EU

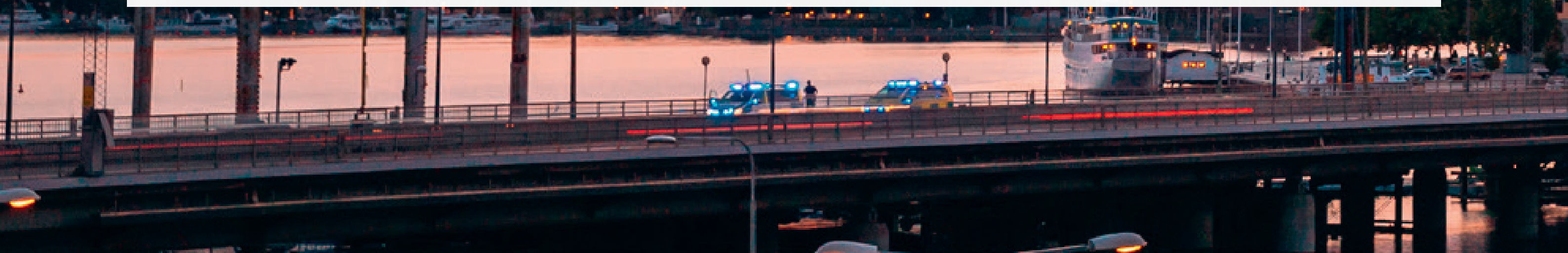
**A key conclusion** of our analysis is that the circular economy agenda remains highly relevant for the EU, with attractive business opportunities and new economic activity to build on even as the continent grapples with the effects of the COVID-19 crisis. But action is needed to maintain the momentum and safeguard the progress already made, and to capture the opportunity of incorporating circular economy measures into stimulus programmes. The EU also has strong reasons to continue to pursue the substantial long-term value, as most of the effort required can proceed hand-in-hand with near-term economic recovery.

**The need for policy** reflects the many barriers. They range from coordination, to unpriced externalities, a need for further innovation, inadequate information, societal norms, and the sheer inertia of large established models of providing mobility, housing, food and more. Policy measures are thus essential if economically attractive shifts towards a more circular economy are to happen.

**Energy efficiency** offers an analogue. It has been an active policy area since at least the 1970s, and significant effort has gone into identifying the potential available, and into understanding the barriers that prevent economically and environmentally attractive measures from being taken up. In response, policy-makers have taken a wide range of approaches: aggregate targets, quota systems, financing mechanisms, subsidies, procurement schemes, and detailed product-level standards and labelling schemes. These, in turn, are rooted in detailed analyses of the complex set of transformations required, and of the barriers that stand in the way.

**The circular economy** agenda investigated in this report is a much younger and less developed field of policy, but it requires a similarly multifaceted approach. Policy will need to span multiple sectors and approaches. Some will take policy-makers into new territory, especially where the benefits depend on deep and systemic change in mobility systems, built environment, and more.

**The EU has taken steps** in this direction already. It first launched its Circular Economy Action Plan in 2015 and further increased the ambition level in the latest launch, in March 2020. Several Member States have also put forward circular economy strategies.[117] This is breaking some new ground. For example, a major departure is the first attempt to incorporate product policies into the overall circular economy policy toolkit via the proposed Sustainable Product Framework. Another is to establish mechanisms to directly drive market demand for circular business models, via mechanisms such as recycled content requirements. Policy-makers will need to continue to develop this policy environment that enables more of the attractive potential to be captured in the next few years, and businesses need to continue to invest in the creation of new business models.



*Policy measures are essential if economically attractive shifts towards a more circular economy are to happen.*

**Our analysis has not investigated** the merits of specific policy instruments, so we do not offer recommendations for which specific policy tools to use. Instead, we outline the key elements needed to continue to advance circular economy measures, especially as this relates to the current economic crisis: measures that are now at risk, those with stimulus potential, and those that offer opportunities for longer-term growth and value creation. To characterise this, we divide policy actions into four broad categories (see Exhibit 23):

- **Set directions and targets:** Measures that set the overall direction and establish metrics and targets. Experience from other policy areas is that they can create conviction, enable coordination, and reduce risk by indicating the policy landscape ahead.

- **Create enablers and remove barriers:** Policies to address the multiple non-financial barriers to the circular economy transition. These concern a broad range of factors: where it cannot be expected that private actors can contract with each other, where coordination is required, where current regulations stand in the way, where there are other market failures, etc.

- **Make the economics work:** These policies focus on improving the financial business case for circular economy solutions. As noted throughout this report, there are many examples where charges for environmental impact would tilt the business case substantially, or where initially higher costs can be reduced by helping solutions travel down the learning curve. Likewise, policy can support the economics of circular economy measures by creating lead markets and stimulating demand.

- **Make public investments:** Public investment is perhaps the most direct tool for governments and other policy-makers. This includes direct investments in new circular economy activity, but also the incorporation of circular economy principles into existing large areas of public intervention – notably infrastructure, the built environment and transportation systems.

**These four areas give a sense** of the wide variety of options available. A full policy programme must of course consider how they fit together, with several important considerations:

**First, different policy approaches** often are complementary and work best when combined into a coherent whole. For example, the motivation behind product policy is often that it improves the viability of opportunities that would be expensive to address through economic incentives alone (e.g. because the value created downstream does not accrue to the initial manufacturer of a product). This is thus a case where addressing a non-financial barrier can also improve the economics.

**Second, policy will be the most effective** not by seeking to create a separate "circular economy sector", but by enabling the application of circular economy principles throughout the economy. Much of the potential discussed in this report consists not of replacing current activity, but of gradual transformations as circular economy opportunities are taken up in existing sectors and businesses. As noted throughout this report, there are numerous examples: from changes to current infrastructure planning, to extensions of mobility services, combined use of recycled and virgin materials, complementing existing construction practices with reuse models, gradually shifting agricultural practices, etc.

**Third, there is a need for careful balancing.** Manoeuvring these complex topics is often tricky, and policy-makers must be careful not to introduce unintended consequences or regulatory costs. Especially where non-financial barriers are the target, authorities must tread carefully to avoid creating any unnecessary red tape or unintended effects. Where there is such risk, policy-makers can help by phasing implementation, and by providing support to companies that face transition costs.

*Exhibit 23*

# TOOLS AND ACTIONS THAT POLICY-MAKERS CAN USE TO SUPPORT CIRCULAR ECONOMY ACTIVITIES

## SET DIRECTION AND TARGETS

- *Convincing communication of circular economy as the future vision*
- *Clear high-level targets (e.g. on $CO_2$ reduction, landfill, recycling)*
- *Integration of circular economy with other key agendas (industrial strategy, resilience, climate)*
- *New metrics to track progress and measure performance*

## CREATE ENABLERS AND REMOVE BARRIERS

- *Product design requirements enabling untapping the potential later in the supply chain*
- *Other company requirements to ensure circularity (e.g. 'right to repair')*
- *Improved transparency (e.g. harmonisation of standards/labels, requirement on information declaration)*
- *Revise barriers in existing regulations (e.g. waste transportation)*
- *Promote and enable collaboration (e.g. Industry Alliances)*

## MAKE THE ECONOMICS WORK

- *Taxes to reflect full externalities (e.g. embodied emissions)*
- *Implement circular economy aspects in trade policies*
- *Support, incentives and rewards for circular solutions*
- *Extended producer responsibility (EPR)*
- *Quotas for circular economy activity (e.g. recycled content, materials efficiency targets)*
- *Public procurement*

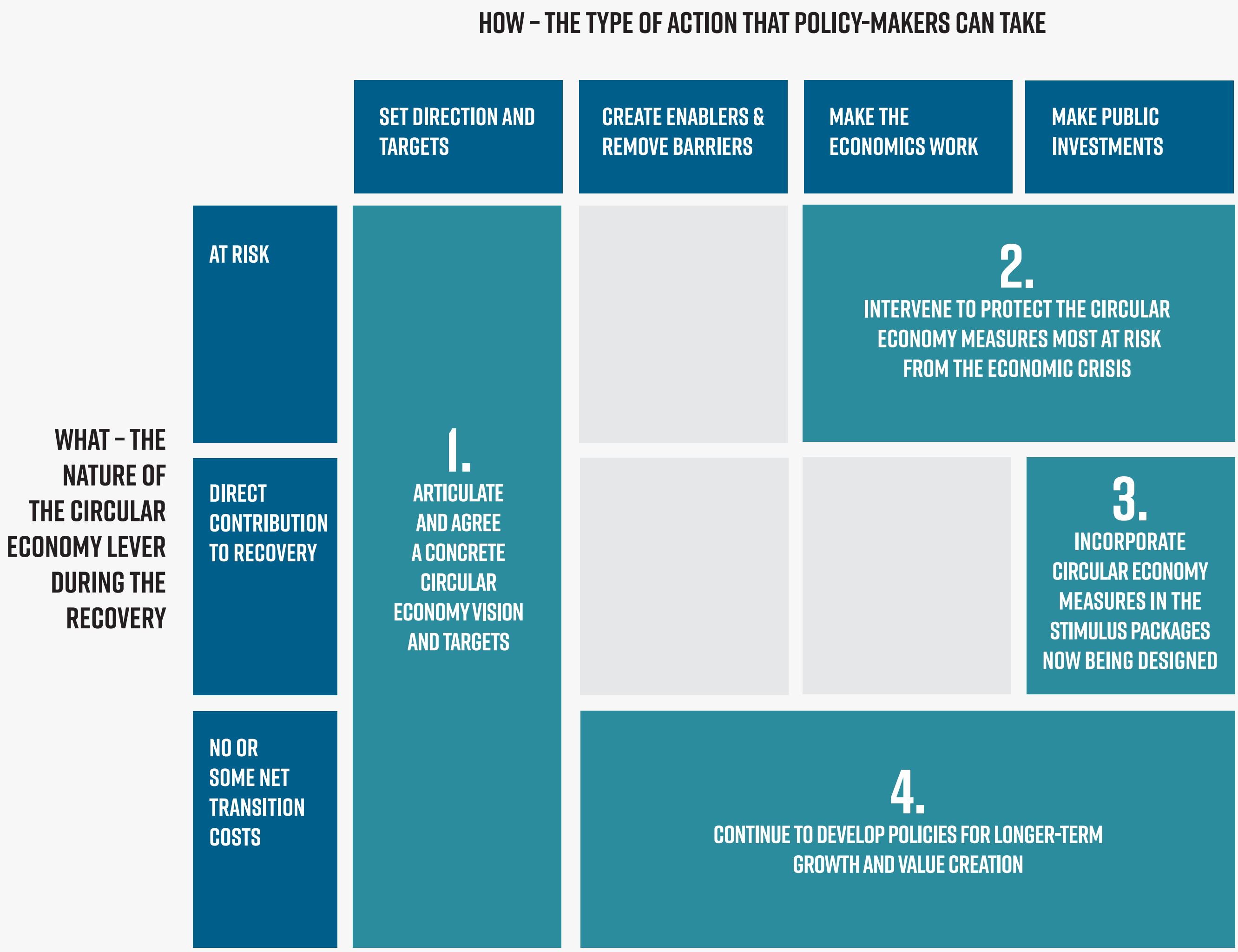
## MAKE PUBLIC INVESTMENTS

- *Investment in circular economy infrastructure, support for company transition investments, investments in innovation, including technology development and diffusion*
- *Integration of circular economy when planning and designing major systems such as mobility, built environment and food systems*
- *Financial instruments to promote private investments*

**With that in mind,** we consider what categories of policy interventions are most relevant to align circular economy policy with the new situation of economic downturn and recovery efforts. Specifically, different actions are required for those circular economy opportunities that are at risk, those with stimulus potential, and those that offer opportunities towards longer-term growth and value creation (see Exhibit 24). To fully capture the potential of circular economy, larger system transformations are needed as well[i].

*Exhibit 24*

## THE TYPE OF MEASURES USED BY POLICY-MAKERS SHOULD DEPEND ON THE NATURE OF THE CIRCULAR ECONOMY LEVER DURING THE POST-COVID RECOVERY




[i] *see SYSTEMIQ's forthcoming report on "A System Change Compass"*

## 4.1. ARTICULATE AND AGREE A CONCRETE CIRCULAR ECONOMY VISION AND TARGETS

**The first insight** is the importance across the board of setting a clear vision and target – both for policy and for companies. The Circular Economy Action Plan and the EU Industrial Strategy are significant steps in the right direction. However, the pandemic and the resulting economic crisis have created increased uncertainty in the market, spilling over to circular economy efforts that are often still in their early stages.

**An important parallel** can be made to climate strategies and targets. The very clear goals on how GHG emissions need to decrease until reaching a net-zero scenario in 2050 has been a powerful driver of investments, technology development and innovation. While there has been much debate about the merits of specific targets and their interaction (e.g. for renewable energy or energy efficiency), it is clear the overall exercise of uniting around future descriptions of how the energy system should work has made a major impact, and have helped coordinate a successful push to drive down costs of renewable energy and many other key technologies for decarbonisation.

**For the circular economy,** the EU policy framework already includes targets, but often only at highly specific levels (e.g. degrees of recycling for specific materials, or the treatment of end-of-life flows from particular product categories). For a more assertive vision, targets could be denominated in terms of the major economic factors that drive economic value from a circular economy: 1) increased capital productivity through increased lifetime and utilisation of capital assets and durable products, 2) reduced waste and increased efficiency in the product and materials use of key value chains, and 3) mobilisation of new resources through effective and high-value circular materials systems. This is closely related to developing the right metrics to steer by – an ongoing debate with a lot of potential.

**Targets in this domain** would help drive a highly relevant agenda for economic recovery. For the circular economy measures that are at risk due to the COVID-19 crisis, reaffirming commitments to future targets will help companies get through this difficult period. They may be able to secure additional finance and continue rather than scrap initiatives that have been under way. For measures with stimulus potential, the commitment to future markets for circular economy business models can underpin the mobilisation of private capital to complement direct public investment.

## 4.2 INTERVENE TO PROTECT THE CIRCULAR ECONOMY MEASURES MOST AT RISK FROM THE ECONOMIC CRISIS

**For circular economy** activities that are vulnerable to specific challenges created by the COVID-19 economic crisis, targeted interventions may be necessary. As noted, these impacts include short-term market disruption, commodity price swings, a drying up of investment, and reduced liquidity. Policy to help counteract this would thus focus less on long-term targets or structural enablers, and more on improving the short-term financial case, and bringing forward investment that otherwise risks being postponed or cancelled.

**Some of this** (such as support for liquidity) is often best dealt with through broad support programmes that are not specific to circular economy businesses. However, there are several areas where policy can provide targeted and temporary relief:

- **Identify and support circular economy** supply chains that have been disrupted, much like has been done for other, especially hard-hit sectors (such as hospitality, airlines or culture). As noted, potential candidates include various forms of recycling activity, many SMEs and start-ups in circular business models, and a range of demonstration and innovation activities.
- **Consider temporary support** financial measures to counteract the economic fallout from changes in raw materials prices, where these risk causing long-term damage to EU circular economy capacity. As noted, this is a major issue for plastics recycling (see Exhibit 12) and also affects aluminium recycling (Exhibit 9). Price supports for recycled output benchmarked against virgin commodity prices could be one such option, providing a stabiliser against the uncertainty that the economic crisis has brought.
- **Identify and support planned** investments that risk being postponed or cancelled specifically due to the crisis. Such capital expenditure is often the first casualty as businesses tighten their belts and act to safeguard against uncertainty. Support for continued investment can take many different forms, further discussed below.

**Such targeted interventions** can only go so far and cannot be the basis for building a long-term business case. For maximum effect on public funds, it is important that to complement these by continuing to implement an overall policy framework (see below).

## 4.3. INCORPORATE CIRCULAR ECONOMY MEASURES IN THE STIMULUS PACKAGES NOW BEING DESIGNED

**Many recovery programmes** now foresee a significant increase in direct public investment to counteract the economic crisis. As noted in the preceding chapter, there are a host of circular economy themes that provide a very good fit with this agenda. Since the recovery and resilience plans are implemented on a national level, Member States will be key actors in joining circular economy and stimulus efforts.

**Policy-makers can use** the public investment tool for several purposes in the recovery agendas now being developed:

- **First, governments can make** direct public investments. Governments already are major investors in national and city-level infrastructure (e.g. mobility systems, the built environment, and water and sanitation), and set the terms for investment in major network infrastructure undertaken by private companies. There are many examples where this can be tailored to support a more circular economy, from investments in fast-charging infrastructure and multimodal transport systems, to waste collection systems and recycling facilities, municipal infrastructure, new vehicle platforms, or biogas production capacity (see Exhibits 15 and 16 for more concrete examples).
- **Second, policy-makers can** provide support to private and company investments with promising circular business models. This involves a familiar toolkit of blended finance and partnerships, such as guarantees, concessional loans, capex grants, or direct investments. Such public support is especially effective where it helps mobilise further private investment.[118]

## 4.4. CONTINUE TO DEVELOP POLICIES FOR LONGER-TERM GROWTH AND VALUE CREATION

**Much of the circular economy** transition cannot be driven by one-off financial rescue packages or by public investment, but must be propelled instead by systematic long-term private investment and business creation. Further building on the policy agenda already defined by the Circular Economy Action Plan and national strategies is thus as important as it was before the crisis.

**First, there is a need** for a more comprehensive approach to address non-financial barriers. Circular economy opportunities rely on coordination of value creation along the entire cycle, from product design and manufacture, through all stages of use. This also means that any blockages (or information flow, of contracting between parties, of risk-sharing, etc.) rapidly get in the way of new business models. For example, producers often lack incentives to design products for subsequent reuse, repair, remanufacture, or recycling – as the value often accrues many years later, to parties with whom they have no direct dealings, and in ways that mean that the original producer often cannot capture that value (economists would call this market failure an "incomplete contract").

**Digitisation is creating new ways** to get around such disconnects. For example, it can reduce the transaction costs and information problems of sharing business models; enable distributed tracking of products or of their content; and provide automation solutions that enable a wide range of practices, from autonomous vehicles to much more advanced sorting of materials. These, in turn, enable new business models to share the value created by circular economy principles. Enabling the digital platforms and infrastructure required for the circular economy is therefore a very important agenda.

**Beyond this,** policy-makers can take steps to directly assist with the coordination that market actors otherwise find difficult. The proposed Sustainable Product Framework is one example of an attempt to do this, by directly regulating the coordination and outcomes that otherwise cannot be expected. Still, there is much more to explore in this area, and to better understand the potential available and the enablers required.

**Second, the financial aspects** of circular economy business models need a much more systematic treatment if the full circular economy potential is to be captured. As noted, materials markets are global, and key externalities in many markets (whether $CO_2$ in production, or air pollution from mobility systems, or eutrophication from agriculture) are not reflected in prices. Compared with other policy areas, such as energy, there is very little systematic policy to level the playing field so that it reflects broader societal objectives.

**A particular area** that has been largely unexplored is that of creating the demand-side signal for circular economy solutions. For example, recycling has been encouraged almost entirely by stipulating targets for how end-of-life products or waste are treated, and to generate recycled output (supply), but with no simultaneous incentive to use recycled products (demand). The result often has been lopsided, with recycling output that has few takers (e.g. in the case of plastics), or with promising, high-quality recycling solutions financially out of reach because they can be more expensive than using (often imported) virgin materials. Recycled content requirements are one attempt to redress this imbalance. The much broader agenda is to address how a strong demand-side signal can be created for a range of circular economy solutions, beyond recycling.

**Finally, the public sector** remains an important actor also in the longer term – in cities, infrastructure, mobility systems, the built environment, and more, and as a major buyer of goods and services. Investments undertaken or enabled by the public sector thus remain an important potential lever also in the longer term, beyond the immediate stimulus programmes undertaken in response to the current economic crisis.

# 5. APPENDIX

## 5.1 MAIN METHODOLOGY AND ASSUMPTIONS BEHIND QUANTIFICATION

**The modelling of the economic** potential of a more circular economy builds on the approach and models described in Growth Within (2015), where the impact on resource cost and externalities from a more circular economy by 2030 was quantified for the sectors mobility, housing and food. The report defined over 30 circular economy levers, covering improved productivity of capital assets, reduced waste and improved efficiency in production, and a more diversified and expanded resource base.

**The approach builds on** several steps, including assessments of the potential for each lever, the economic and resource implications of their adoption, and investment requirements. Their uptake is explored in different scenarios, reflecting assumptions about policy ambition, technology status and development, and factors such as the interactions between different actions.

**This study revisits and updates** these assessments to reflect conditions in 2020. The baseline and future scenarios have been updated to reflect developments and trends since the original model was done. More specifically, we have updated the assumptions both in terms of the activity levels in 2020 and 2030 (where applicable), as well as in terms of the relative development until 2030. A new baseline scenario is referred to as "business as usual" (BAU) 2030 in following tables. The circular scenario presents an ambitious transformation, with adoption across all areas of the circular economy. The main assumptions and assessment are presented in Table 5.1.1 below. We also describe the impact on externalities even if this is not considered in the estimates of the potential 2030. The list of levers is not exhaustive.

**As in any scenario analysis,** there are major uncertainties. We therefore explore sensitivities and ranges for many of the factors, also presented below.

# TABLE 5.1.1 – DESCRIPTION OF CIRCULAR ECONOMY LEVERS AND KEY ASSUMPTIONS

| CIRCULAR LEVER | LEVER DESCRIPTION AND OUR KEY ASSUMPTIONS |
|---|---|
| **MOBILITY** | |
| **Ride sharing (incl. public transport)** | Average number passengers per car is assumed to increase slowly in BAU 2030 through increased ride sharing but reduced public transport use, however increasing more in CE 2030 through both increased ride sharing and increased public transport use. Development is very uncertain as it depends on shifting behaviours, and potentially also negatively impacted by reduced TCO from shared car systems. Also, externalities reduced through reduced air pollution, less congestion, fewer accidents, reduced noise levels etc. |
| **Car sharing** | Share of car-km in shared cars assumed to grow in both BAU 2030 in CE 2030. This has positive spill-over effect, such as enabling more variation in car sizes, improved maintenance and durability through professional fleets etc. Externalities are primarily reduced through lower $CO_2$ emissions from car production. |
| **Optimise** | Energy efficiency of engines continues to improve, and both scenarios assume improvements by 2030 across engine types. This has positive impact on fuel consumption, saving both resource costs and reducing externalities related to $CO_2$ emissions and air pollution. |
| **Looping** | Procurement of virgin materials assumed to decrease from BAU 2030 to CE 2030 through increased share of recycled and remanufactured material. The impact on resource cost is relatively small, however this lever provides large business opportunities as well as reduces $CO_2$ emissions from "hard-to-abate" sectors such as steel and aluminium. |
| **Autonomous driving** | Share of autonomous cars in a shared car system is assumed to increase but number of total cars decrease -> assumed at similar levels in BAU 2030 and CE 2030. As technology can optimise traffic flows and reduce car weight from steering mechanism, this reduces fuel consumption (affecting both resource costs and externalities related to $CO_2$ emissions) as well as congestion and number of accidents. |
| **Virtualise travel** | Virtualised travel is assumed to increase from today's level to BAU 2030 and CE 2030 (N.B "Today" reflects 2020 without COVID-19). The COVID-19 crisis has had big impact on the uptake of tele-conferencing technologies, increasing uncertainty of future development. It is possible that some of the impact on daily commutes will remain after the crisis, perhaps making the assumptions for 2030 too conservative. Benefits encompass all areas, including substantial externalities savings through decreasing number of passenger km. |
| **Durable and lightweight car design** | Shared cars are assumed to be more durable than owned cars, due to design to maximise run time, shift to EVs and predictable maintenance. Average car lifetime is assumed to increase in both BAU 2030 and CE 2030 and car weight is assumed to be reduced in both scenarios. This impacts fuel consumption, reducing resource cost and externalities in terms of reduced air pollution and $CO_2$ emissions. |
| **Electric vehicles** | Uptake of EVs is assumed to increase in a shared car system as sharing enables a broader cover for more capital intensive solutions. In total, this increases electric car-km in BAU 2030 and CE 2030. Higher capital cost is compensated by reduced fuel cost, resulting in savings in resource cost and externalities in terms of reduced $CO_2$ emissions, air pollution and noise levels. |
| **3D printing** | Increased use of 3D printing in production is assumed to reduce waste in production in BAU 2030 and CE 2030 as well as reduce component weight (by enabling more complex design) in both scenarios. This enables resource savings in material costs and externalities savings related to emissions from $CO_2$ intensive materials saved. |
| **Automation** | Through increased use of automation, labour cost of production is assumed to be reduced in both scenarios by 2030. Due to reduced number of cars in CE 2030, savings are somewhat smaller in this scenario compared to BAU 2030. |
| **Other (e.g. renewable energy)** | Renewable electricity assumed to continue increase in BAU 2030 and CE 2030. Economic benefits of reduced energy cost but real benefits are higher from reduced externalities through costs related to $CO_2$ emissions. |

## TABLE 5.1.1 – DESCRIPTION OF CIRCULAR ECONOMY LEVERS AND KEY ASSUMPTIONS

| CIRCULAR LEVER | LEVER DESCRIPTION AND OUR KEY ASSUMPTIONS |
|---|---|
| **BUILT ENVIRONMENT** | |
| **Urban design (incl. vertical building)** | Share of vertical buildings in new built is assumed to increase in BAU 2030 and CE 2030. Although no resource cost benefits have been estimated related to this, it reduces transport opportunity costs through urban densification. |
| **Residential sharing** | Sharing optimises use of residential space significantly reduces cost of housing and reduces externalities through lower demand for $CO_2$-intensive input materials. Both 2030 scenarios assume an increase in % of housing costs shifts to shared model relative to today (N.B "Today" reflects 2020 without COVID-19). Development is uncertain as it is directly affected by COVID-19 as well as depends on changed behaviours. |
| **Industrialised processes** | Improved efficiency of construction through increase of pre-fabrication (prefab) construction techniques, assuming penetration in newly built today to increase in both 2030 scenarios. This reduces waste in construction, with positive impact on material cost, cost of transport, $CO_2$ footprint of construction, etc. |
| **Passive housing** | Share of passive houses in new built is assumed to increase in BAU 2030 and CE 2030. Construction of passive houses reduces energy consumption heavily and saves utilities costs as well as externalities (related to $CO_2$ emissions) |
| **Energy efficiency** | Energy efficiency of existing building stock is assumed to be improved in BAU 2030 and CE 2030 (in % of heating and cooling energy). Energy efficiency is enabled through smart solutions for newly built and renovation for existing buildings and saves energy costs as well as reduces externalities through lower demand for $CO_2$-intensive energy. |
| **Durability** | Newly built is assumed to have a longer lifetimes in BAU 2030 and CE 2030. Longer lifetime of buildings saves capital costs as well as reduces externalities through reduced demand for $CO_2$ intensive materials |
| **Looping** | Rate of recycling and remanufacturing of building material in newly built is assumed to increase in both 2030 scenarios. For this share, the material costs are assumed to decrease. In turn, this reduces externalities through reduced demand for $CO_2$-intensive materials. |
| **Modularity** | Modular construction techniques in new buildings is assumed to increase in BAU 2030 and CE 2030. This technique enables a quicker and more optimised production saving resource costs and externalities through e.g. reduced waste and improved reconfiguration flexibility. Economic savings are low due to being a low share of existing stock. |
| **3D printing/automation** | 3D printing in construction of newly built assumed to increase in BAU 2030 and CE 2030. 3D-printing enables automated zero-waste production – unlocking savings in material and labour costs as well as reduced externalities through reduced demand for $CO_2$-intensive input materials. |
| **Other (e.g. renewable energy)** | Renewable electricity assumed to continue increase in BAU 2030 and CE 2030. Economic benefits of reduced energy cost but real benefits are higher from reduced externalities through costs related to $CO_2$ emissions. |

# TABLE 5.1.1 – DESCRIPTION OF CIRCULAR ECONOMY LEVERS AND KEY ASSUMPTIONS

| CIRCULAR LEVER | LEVER DESCRIPTION AND OUR KEY ASSUMPTIONS |
|---|---|
| **FOOD** | |
| **Agriculture and post-harvest handling and storage** | Assumed reduction of food waste in agriculture and post-harvest handling and storage through optimisation in BAU 2030 and CE 2030. Reducing resource cost through improved efficiency and reducing externalities across agriculture process through reduced demand for agricultural products that would have gone to waste– reducing the need for inputs such as water, synthetic fertilisers, pesticides, fuel for transport and thus reducing $CO_2$ emissions. |
| **Processing** | Assumed reduction of waste in food processing through optimisation in BAU 2030 and CE 2030. Reducing resource cost through improved efficiency and reducing externalities through lower demand for agricultural products. |
| **Distribution retail** | Assumed reduction of waste in food distribution and retail through optimisation in BAU 2030 and CE 2030. Reducing resource cost through improved efficiency and reducing externalities through lower demand for agricultural products. |
| **Consumer** | Assumed reduction of consumer food waste through optimisation in BAU 2030 and CE 2030. Higher uncertainty due to behavioural change. Reducing resource cost through lower volume of food purchases and reducing externalities through lower demand for agricultural products. |
| **Precision farming** | Assumed reduced costs through use of precision farming technology (such as GPS-based machinery, drones, smart irrigation etc.) in BAU 2030 and CE 2030. High uncertainty due to technology under development as well as transition costs (incl. behavioural dimension) for farmers. Reducing externalities through reduced use of fertilisers. |
| **Organic farming** | Organic farming represents a small share of agricultural land today and is assumed to increase in BAU 2030 and CE 2030. Generates negative resource savings through higher labour intensity but leads to reduced externalities through reducing need for synthetic fertilisers and pesticides. |
| **Online grocery shopping** | Online grocery shopping assumed to reduce waste through, e.g., pooled distribution and improved planning in BAU 2030 and CE 2030 for retail and consumers. Reduced food volumes purchased reduces resource costs. and externalities through reduced demand for agricultural products that would have gone to waste. |
| **Restore degraded land** | Soil restoration assumed to not affect costs in BAU 2030 but lead to increased costs in CE 2030 due to limited penetration today and high transition costs. Creates resource savings through more productive use of land and saves externalities through reduced GHG emissions (e.g. from improved water recirculation and carbon sequestration). |
| **Nutrient recovery** | Nutrient recovery (in share of nutrient input) is assumed to increase in BAU 2030 and CE 2030. Saves resource costs through reduced need for synthetic fertilisers which also reduces externalities such as reduced water eutrophication. |
| **Share machinery** | Sharing of agricultural machines assumed to increase in BAU 2030 and CE 2030 – low penetration rates due to lock-in periods to existing machines as well as behavioural transition costs (increasing uncertainty of development). Saves resource costs through decreased capital cost and reduces externalities through lower demand for $CO_2$-intensive material used to construct machines. |
| **Extract biogas from waste/anaerobic digestion** | Anaerobic digestion of waste assumed to increase in BAU 2030 and CE 2030. Although no economic benefits have been modelled, beneficial through reducing externalities in terms of avoiding costs related to methane and $CO_2$ emissions. |
| **Extract chemicals from waste** | Using organic waste for the extraction of chemicals through biorefineries is assumed to amount to increase in BAU 2030 and CE 2030. Dependency on technological development increases uncertainty. Reduces resource costs and externalities through reduced demand for input chemicals. |

## 5.2 ASSESSMENT OF LEVERS AT RISK

**As described in the report,** current economic situation poses several different risks to the circular transition (Chapter 3). The quantification of the economic potential at risk explores the impact of delayed adoption of measures, and of permanently slower growth for solutions particularly sensitive to changes wrought by the economic crisis (such as changes in raw materials prices). Table 5.2.1 summarises the main mechanisms included.

### TABLE 5.2.1 – ASSESSMENT OF CIRCULAR LEVERS AT RISK

| CIRCULAR LEVER | DESCRIPTION OF WHAT IS AT RISK (NON-EXHAUSTIVE) |
|---|---|
| **MOBILITY** | |
| **Ride-sharing** | Near-term decrease in ride sharing due to social distancing, however might last longer due to stickiness of habits and car investments. |
| **Car-sharing** | Risk of decreased transport need due to virtualised travel but also a potential increase in car sharing due to shift away from public transport; Potential financial challenges for SMEs. |
| **Optimise** | Risk of delayed investment of R&D in energy efficiency programmes. |
| **Looping** | Risk of delayed investment in initiatives such as re-manufacturing & recycling facilities. |
| **Autonomous driving** | Risk of delayed investments in R&D and liquidity problems for autonomous driving SMEs. |
| **Virtualise travel** | Limited risk due to increased adoption due to COVID-19. |
| **Durable and lightweight car design** | Risk of delayed R&D investments and reduced capacity to take on process innovation. |
| **Electric vehicles** | Risk of slow-down of momentum and delayed investments (e.g. R&D, fast charging infrastructure). |
| **3D printing** | Risk of delayed R&D investments and liquidity problems for 3D-printing SMEs. |
| **Automation** | Risk of delayed R&D investments and liquidity problems for automation SMEs. |
| **Other (e.g. renewable energy)** | Risk of delayed investments. |
| **BUILT ENVIRONMENT** | |
| **Urban design (incl. vertical building)** | Limited risk due to assumption that investments in long-term urban design projects stay constant. |
| **Residential sharing** | Reduced residential house sharing due to social distancing and assumingly in the short term after due to stickiness of rental contracts and property investments. |
| **Industrialised processes** | Risk of reduced penetration of pre-fabrication construction techniques due to delayed investments and reduced capacity to take on process innovation. |
| **Passive housing** | Risk of reduced penetration of passive houses due to delayed investments and reduced capacity. |
| **Energy efficiency** | Risk of reduced energy efficiency renovations due to delayed investments and reduced capacity. |
| **Durability** | Risk of delayed investments and reduced capacity to take on process innovation. |
| **Looping** | Risk of delayed investment in looping initiatives such as recycling facilities for demolition waste. |
| **Modularity** | Risk of decreased adoption of modular construction techniques due to reduced risk-appetite. |
| **3D printing/automation** | Risk of delayed investments in technology and liquidity problems for 3D printing and automation SMEs. |
| **Other (e.g. renewable energy)** | Risk of delayed investments. |
| **FOOD** | |
| **Food waste reduction** | Risk of delayed investments in programmes related to and liquidity problems for SMEs in food waste reduction across the whole value chain. |
| **Precision farming** | Risk of delayed investments in technology and reduced risk-appetite to switching farming practice. |
| **Organic farming** | Risk of delayed investments in organic farming programmes and reduced risk-appetite to switching farming practice. |
| **Online grocery shopping reducing distribution, retail and consumer waste** | Limited risk due to increased adoption due to COVID-19. |
| **Restore degraded land** | Risk of delayed investments in soil restoration programmes and reduced risk-appetite to enter a transition period. |
| **Nutrient recovery** | Risk of delayed investments in nutrient recovery programmes. |
| **Share machinery** | Limited direct risk from social distancing due to nature of machines (sharing an agricultural machine can be done without physical interaction) but involves liquidity risks for machinery sharing SMEs. |
| **Extract biogas from waste/ anaerobic digestion** | Risk of delayed investments in construction of anaerobic digestion plants. |
| **Extract chemicals from waste** | Risk of delayed R&D investments in chemical extraction plants. |

# 5.3 ASSESSMENT OF CIRCULAR ECONOMY LEVERS BASED ON NEAR-TERM ECONOMIC IMPACT

**The assessment of circular economy** actions builds on the circular levers from Growth Within (2015) as described in the previous section. Each lever has been broken down into several actions that need to be undertaken to realise the potential and the total economic potential by 2030 for the lever has been distributed across its actions. Each of the actions has been assessed for their contribution to economic recovery, using the framework presented in Chapter 1 – that is, whether the action 1) has the potential to mobilise idle resources in the near term (within five years) or 2) the near-term economic benefits outweigh the near-term economic costs (with and without accounting for externalities). Thus, the levers can have both stimulative and net cost elements, but to a smaller or larger extent.

**Synergies between different actions** (e.g., the increased financial viability of electric vehicles with more widespread use of ride-sharing) are accounted for in the overall assessment, and such effects are distributed across the relevant levers, where required. The modelling finds that such system effects often are important. One implication of this is that actions with some element of trade-off when looked at in isolation, can be much more beneficial when considered as part of an overall scenario of multiple, parallel actions.

## TABLE 5.3.1 – EXAMPLE OF CIRCULAR LEVERS WITH DIRECT CONTRIBUTION TO RECOVERY

| CIRCULAR LEVER | DESCRIPTION OF ACTION AND STIMULATIVE EFFECT |
|---|---|
| **MOBILITY** | |
| **Looping** | Investment in build-out of recycling capacity such as setting up recycling facilities would mobilise idle resources in the short term. |
| **Virtualise travel** | Further uptake of virtualised travel is stimulative through substantial resource savings in transport cost. |
| **Electric vehicles** | Investment in build-out of fast charging infrastructure and manufacturing capacity of EVs would mobilise idle resources in the short term whilst increased uptake of EVs in shared fleets would be stimulative through saved OPEX. |
| **Other (e.g. renewable energy)** | Investment in further build-out of renewable energy capacity would mobilise idle resources in the short term and provide benefits of reduced energy costs. |
| **BUILT ENVIRONMENT** | |
| **Energy efficiency** | Investment in energy efficiency renovations and smart home solution and appliances would mobilise idle resources in the short term. |
| **Looping** | Investments in materials recovery plants for construction waste would mobilise idle resources in the short term. |
| **Modularity** | Increased adoption of modular construction techniques through e.g. subsidies would be stimulative through lower costs and improved efficiency of construction process. |
| **Other (e.g. renewable energy)** | Investment in further build-out of renewable energy capacity would mobilise idle resources in the short term and provide benefits of reduced energy costs. |
| **FOOD** | |
| **Online grocery shopping reducing distribution, retail waste** | Increased uptake of online grocery shopping through e.g. subsidies is stimulative through substantial savings from reduced food waste. |
| **Nutrient recovery** | Investment in build-out of nutrient recovery infrastructure would mobilise idle resources in the short term and provide resource savings in fertiliser costs. |
| **Extract biogas from waste/anaerobic digestion** | Increased build-out of anaerobic digestion plants through e.g. investments or subsidies would mobilise idle resources in the short term and provide benefits of biogas production. |
| **Extract chemicals from waste** | Investment in R&D for chemical extraction in biorefineries would mobilise idle labour in the short term. |

**Table 5.3.2 below** shows the outcome of the assessment of near-term economic effects, viz. the share of the potential represented by each lever that is estimated to have net near-term costs, as well as the reasoning around the overall near-term economic effect. This includes whether a lever 1) contributes to recovery directly, 2) comes with some net transition cost in the near term or 3) does not impose near-term net costs (but does not stimulate the economy either). The assessment of net near-term costs considers the fact that each lever is complex as its implementation depends on many different types of actions.

## TABLE 5.3.2 – DESCRIPTION OF ASSIGNED SHARE OF POTENTIAL THAT REQUIRE ACTIONS WITH NET NEAR-TERM COST WEIGHT PER LEVER

**ESTIMATED SHARE ACTIONS WHERE COSTS > ECONOMIC BENEFIT IN NEAR TERM AND WHERE COSTS DO NOT MOBILIZE IDLE RESOURCES**

- 2-20% (grey)
- MORE THAN 20% (gold)

| CIRCULAR LEVER | | COMMENT REGARDING THE "MAIN NATURE" OF THE NEAR-TERM ECONOMIC EFFECT |
|---|---|---|
| **MOBILITY** | | |
| **Ride-sharing (incl. public transport)** | 2-20% | Transition expected to take time (incl. behavioural changes, etc.). The benefits and costs to continue the transition during the next few years are expected to weigh out each other and thus not cause a large net transition cost. Direct externality savings with reduced number car-km. |
| **Car-sharing** | 2-20% | Transition expected to take time (incl. behavioural changes etc.). The benefits and costs to continue the transition during the next few years are expected to weigh out each other and thus not cause a large net transition cost. Direct externality savings with reduced number car-km. |
| **Optimise** | 2-20% | Involves high R&D costs now and benefits would not materialise in the short-term (benefits materialise during vehicle lifetime). However, investment would mobilise idle resources in the short term. |
| **Looping** | More than 20% | Benefits would materialise in the long-term as vehicles designed for remanufacturing and recycling reach end of life, and as technology for recovering materials becomes more mature, however, investment in e.g. recycling capacity build-out would mobilise idle resources in the short term. |
| **Autonomous driving** | 2-20% | Benefits would materialise in the long-term when technology is more developed and sufficiently safety-tested, but investment would mobilise idle resources in the short term. |
| **Virtualise travel** | 2-20% | Initial transition costs of setting up technical infrastructure and changing behaviours, but considerable resource savings (and externalities) savings in near term from reducing overall transport need. |
| **Durable and lightweight car design** | More than 20% | Requires R&D costs in near-term and benefits are not realised until the long term, when new cars are fully developed and launched (although highly valuable in a range of areas including e.g. reduced fuel need). |
| **Electric vehicles** | 2-20% | Initial transition costs of higher capital expenditure, but great and direct savings in OPEX-costs (and externalities through reduced emissions, pollution and noise) from increased EV uptake. |
| **3D printing** | 2-20% | Requires further R&D costs as well as transition costs when adopted. Thus, benefits materialise in the long-term when technology and processes becomes more mature. However, R&D investment would mobilise idle resources in the short term. |
| **Automation** | 2-20% | Requires further R&D costs as well as transition costs when adopted. Thus, benefits materialise in the long-term when technology and processes becomes more mature. However, R&D investment would mobilise idle resources in the short term. |
| **Other (e.g. renewable energy)** | 2-20% | Investments contribute to recovery efforts. |

## BUILT ENVIRONMENT

| | |
|---|---|
| **Urban design (incl. vertical building)** | Cost refer to the design phase. Benefits would materialise in the long term when urban design projects are carried out, but great externalities savings to be captured through reducing overall transport need. |
| **Residential sharing** | Further development and penetration of residential sharing solutions would involve transition costs. But when adopted, benefits would materialise quickly enough to balance these costs. |
| **Industrialised processes** | Benefits would materialise in the long term when pre-fabrication technology and process becomes more mature. However investment would mobilise idle resources in the short term. |
| **Passive housing** | Benefits would materialise in the long term (as passive houses are built), but construction would mobilise idle resources in the short term (however, usually more expensive than construction of traditional buildings) |
| **Energy efficiency** | Benefits would materialise in the medium term (as energy efficient renovation/construction have been carried out), but it would mobilise idle resources in the short term. |
| **Durability** | Benefits from building more durable buildings would materialise in the long term (at building end-of-life) but investment would mobilise idle resources in the short term. |
| **Looping** | Benefits from increased recycling of building material would materialise in the long term (at building end-of-life) but investments in e.g. materials recovery plants would mobilise idle resources in the short term. |
| **Modularity** | Initial transition costs to change to modular construction process, but great savings in resource cost and externalities to be captured in the near term to offset these initial costs. |
| **3D printing/automation** | Benefits would materialise in the long term when technology and processes are more developed, but investment would mobilise idle resources in the short term. |
| **Other (e.g. renewable energy)** | Investments contribute to recovery efforts. |

## FOOD

| | |
|---|---|
| **Reducing food waste across value chain** | Reducing food waste involves initial costs to develop waste reducing solutions, but as soon as implemented, near-term economic benefits of reduced food volumes would likely offset these near-term costs. |
| **Precision farming** | Involves high technology development- and transition costs. But when adopted, near-term benefits from e.g. reduced fertiliser input would materialise quick enough to be on par with near-term costs. |
| **Organic farming** | Economic benefits would likely not outweigh high transition costs until in the long-term (although great long-term potential to save externalities from reduced input need). |
| **Online grocery shopping** | Initial transition costs but great near-term savings potential in lower resource cost (and externalities from reduced food waste). |
| **Restore degraded land** | Economic benefits of restoring degraded land would likely not offset the high transition costs in the short-term (although great economic potential in the long-term and substantial savings of externalities). |
| **Nutrient recovery** | Initial transition costs to set up infrastructure but great near-term savings potential in resource cost and externalities from improved recirculation of nutrients. |
| **Share machinery** | Lock-in effects to current machinery. But when adopted, near-term economic benefits of reduced capital cost would materialise quick enough to balance near-term costs of developing sharing machinery solutions. |
| **Extract biogas from waste /anaerobic digestion** | Initial transition costs from setting up infrastructure. Large near term savings when it comes to externalities (reducing GHG emissions). |
| **Extract chemicals from waste** | Initial R&D costs to further develop technology and costs related to set up of infrastructure but large near-term savings potential in resource cost and externalities through reduced demand for virgin chemicals. |

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# THE CIRCULAR ECONOMY AND COVID-19 RECOVERY

*How pursuing a circular future for Europe fits with recovery from the economic crisis*

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