TOWARDS A CIRCULAR ECONOMY: BUSINESS RATIONALE FOR AN ACCELERATED TRANSITION

ELLEN MACARTHUR FOUNDATION

INTRODUCTION

Today's linear 'take, make, dispose' economic model, which relies on large quantities of cheap, easily accessible materials and energy, has been at the heart of industrial development and has generated an unprecedented level of growth.

Yet increased price volatility, supply chain risks, and growing pressures on resources have alerted business leaders and policy makers to the necessity of rethinking materials and energy use – the time is right, many argue, to take advantage of the potential benefits of a circular economy.

A circular economy is one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles. This new economic model seeks to ultimately decouple global economic development from finite resource consumption. A circular economy addresses mounting resource-related challenges for business and economies, and could generate growth, create jobs, and reduce environmental impacts, including carbon emissions. As the call for a new economic model based on systems-thinking grows louder, an unprecedented favourable alignment of technological and social factors today can enable the transition to a circular economy.

This document is an executive summary of the analysis that the Ellen MacArthur Foundation has conducted to date.

SECTION 1: DRIVERS FOR CHANGE AND A NEW ECONOMIC MODEL

The global economy's evolution has been dominated by a linear model of production and consumption, in which goods are manufactured from raw materials, sold, used and then discarded as waste. While great strides have been made in improving resource efficiency, any system based on consumption rather than on the restorative use of resources entails significant losses along the value chain. Furthermore, the rapid acceleration of consumptive and extractive economies since the mid 20th century has resulted in an exponential growth of negative externalities.[1] There is a high likelihood of exacerbating these trends as the global middle class will more than double in size to nearly 5 billion by 2030. Working towards efficiency as a solution – a reduction of resources and fossil energy consumed per unit of economic output – will not alter the finite nature of material stocks but can only delay the inevitable.

A number of factors indicate that the linear model is increasingly being challenged by the very context within which it operates, and that a deeper change of the operating system of our economy is necessary.

Economic losses and structural waste. The current economy is surprisingly wasteful in its model of value creation. In Europe, material recycling and waste-based energy recovery captures only 5 percent of the original raw material value.[2] Analysis has also found significant structural waste in sectors that many would consider mature and optimised. For example, in Europe, the average car is parked 92 percent of the time, 31 percent of food is wasted along the value chain, and the average office is used only 35–50 percent of the time, even during working hours.[3]

Price risks. Recently, many companies have begun to notice that a linear system increases their exposure to risks, most notably volatile resource prices and supply disruptions. Higher resource price volatility can dampen economic growth by increasing uncertainty, discouraging businesses from investing and increasing the cost of hedging against resource-related risks. The last decade has seen higher price volatility for metals and agricultural output than in any single decade in the 20th century.[4]

Supply risks. Many areas of the world possess few natural deposits of non-renewable resources of their own and so must rely on imports. The European Union imports six times as much materials and natural resources as it exports.[5] Japan imports almost all its petroleum and other liquid fuels and its natural gas, and India imports around 80% and 40% respectively.[6] As well as risks to the supply of raw materials themselves, the risk to supply security and safety associated with long, elaborately optimised global supply chains appears to be increasing.

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1 "The Great Acceleration", as coined by the Stockholm Resilience Centre and the International Geosphere-Biosphere Programme, shows that there has been significant acceleration in both socio-economic activity and earth system decline since the 1950s, with little sign of abatement

2 This material value retention ratio is defined as the estimated material and energy output of the European waste management and recycling sector, divided by the output of the raw material sector (adjusted for net primary resource imports and 30 percent embedded resource value in net imported products).

3 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015)

4 Annual price volatility calculated as the standard deviation of McKinsey commodity sub-indices divided by the average of the sub-index over the time frame; Source: Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs, November 2011, McKinsey Global Institute.

5 Frans Timmermans, Jyrki Katainen, Karmenu Vella and Elżbieta Bieńkowska in Die Zeit 'Weg mit der Wegwerfmentalität' (28 May 2015).

6 US Energy Information Administration, Oil and natural gas import reliance of major economies projected to change rapidly (22 January 2014).

Natural systems degradation. A fundamental challenge to long-term global wealth creation is the set of negative environmental consequences related to the linear model. Depletion of low-cost reserves, and increasingly, the degradation of natural capital are affecting the productivity of economies. Elements contributing to these environmental pressures include climate change, loss of biodiversity and natural capital, land degradation, and ocean pollution.[7]

Regulatory trends. In recent years, businesses have witnessed an increased effort on the part of regulators to curtail and price negative externalities. Since 2009, the number of climate change laws has increased by 66%, from 300 to 500.[8] Carbon pricing, in the form of an emissions trading scheme or a carbon tax, has been implemented or is scheduled to commence in almost 40 countries and over 20 cities, states and regions.[9] In Europe, 20 countries levy landfill taxes, which together raised revenues of €2.1 billion in 2009/2010.[10]

Against this backdrop, the call for a new economic model is getting louder. There's increasing evidence of organisations, businesses, and prominent figures explicitly working towards this goal: organisations such as B Lab are working towards the "road to a new economy", serving a global movement of entrepreneurs that use the power of business to generate positive impact; "The B Team" consists of a number of prominent business leaders committed to "the end of business as usual". Long-term perspectives are gradually coming back towards the centre of the stage.

In this context, the circular model of growth, decoupled from the consumption of finite resources and capable of delivering resilient economic systems, is increasingly looked upon as the next wave of development. An unprecedented favourable alignment of technological and societal factors is now making the transition to a circular economy possible at scale.

Advances in technology. Guided by circular economy principles, technological advances can create ever-greater opportunities for society. Information and industrial technologies are now coming online or being deployed at scale, which allow the creation of circular economy business approaches that were previously not possible. These advances allow more efficient collaboration and knowledge sharing, better tracking of materials, improved forward and reverse logistics set-ups, and increased use of renewable energy.

Acceptance of alternative business models. A new model of transaction is emerging, in which individuals embrace business models that enable them to access services rather than owning the products which deliver them, thus becoming users. This has been demonstrated in some markets: rental, performance-based and sharing models, enabled by new technologies, are already finding ready customers, and experiencing exponential growth.

Urbanisation. For the first time in history, over half of the world's population resides in urban areas. Continued urbanisation and overall demographic growth is projected to add another 2.5 billion people to the urban population by 2050,

7 See "Growth Within: a circular economy vision for a competitive Europe" report, Chapter 1 for more detailed information on natural systems degradation

8 M. Nachmany, S. Fankhauser, T. Townshend, M. Collins, T. Landesman, A. Matthews, C. Pavese, K. Rietig, P. Schleifer and J. Setzer, The GLOBE Climate Legislation Study: A Review of Climate Change Legislation in 66 Countries. Fourth Edition (London: GLOBE International and the Grantham Research Institute, London School of Economics, 2014).

9 World Bank and Ecofys, Carbon pricing watch 2015 (May 2015).

10 European Environmental Agency (EEA), Overview of the use of landfill taxes in Europe (2012).

bringing the proportion of people living in cities to 66%.[11] With this steady increase in urbanisation, the associated costs of many of the asset-sharing services and the costs for reverse cycles, collecting and treating end-of-use materials will all benefit from much higher drop-off and pick-up density, simpler logistics, and greater appeal and scale for service providers.

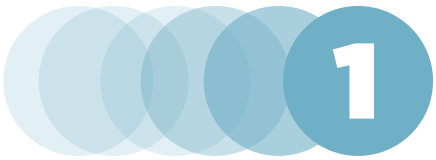
Whilst still pervasive, the linear lock-in is getting weaker in the wake of powerful disruptive trends that will shape the economy for years to come. The rationale for transitioning to a circular model is increasingly documented, and the size of the economic opportunity - as well as the broader set of positive impacts - is gradually emerging both from an analytical perspective and through the compelling case studies provided by early adopters.

SECTION 2: RETHINKING VALUE CREATION – THE CIRCULAR PERSPECTIVE

The notion of a circular economy has attracted increased attention in recent years. The concept is characterised, more than defined, as an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles. It is conceived as a continuous positive development cycle that preserves and enhances natural capital, optimises resource yields, and minimises system risks by managing finite stocks and renewable flows. It works effectively at every scale. This economic model seeks to ultimately decouple global economic development from finite resource consumption.

Major schools of thought related to the circular economy emerged in the 1970s but gained prominence in the 1990s. Examples include the functional service economy (performance economy) of Walter Stahel;[12] the "cradle to cradle"® design philosophy of William McDonough and Michael Braungart;[13] biomimicry as articulated by Janine Benyus;[14] the industrial ecology of Reid Lifset and Thomas Graedel;[15] natural capitalism by Amory and Hunter Lovins and Paul Hawken;[16] and the blue economy systems approach described by Gunter Pauli.[17]

The circular economy rests on three principles, as shown in Figure 1.



Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows. This starts by dematerialising utility – delivering utility virtually, whenever optimal. When resources are needed, the circular system selects them wisely and chooses technologies and processes that use renewable or better-performing resources, where possible. A circular economy also enhances natural capital by encouraging flows of nutrients within the system and creating the conditions for the regeneration of, for example, soil.

11 United Nations, World Urbanization Prospects – The 2014 Revision (2014).

12 W. R. Stahel, The Performance Economy, Palgrave Macmillan, 2006.

13 W. McDonough and M. Braungart, Toward a Sustaining Architecture for the 21st Century: The Promise of Cradle to Cradle Design, Industry & Environment, 2003.

14 J. Benyus, Biomimicry, HarperCollins, 2003.

15 R. Lifset and T. E. Graedel, Industrial Ecology: Goals and Definitions, In R. U. Ayres and L. Ayres (ed.), Handbook for Industrial Ecology, Brookfield: Edward Elgar, 2001.

16 P. Hawken, A. Lovins, and L. H. Lovins, Natural Capitalism: Creating the Next Industrial Revolution, BackBay, 2008.

17 G. Pauli, Blue Economy: 10 Years, 100 Innovations, 100 Million Jobs, Paradigm Pubns, 2010.

FIGURE 1: OUTLINE OF A CIRCULAR ECONOMY

PRINCIPLE 1

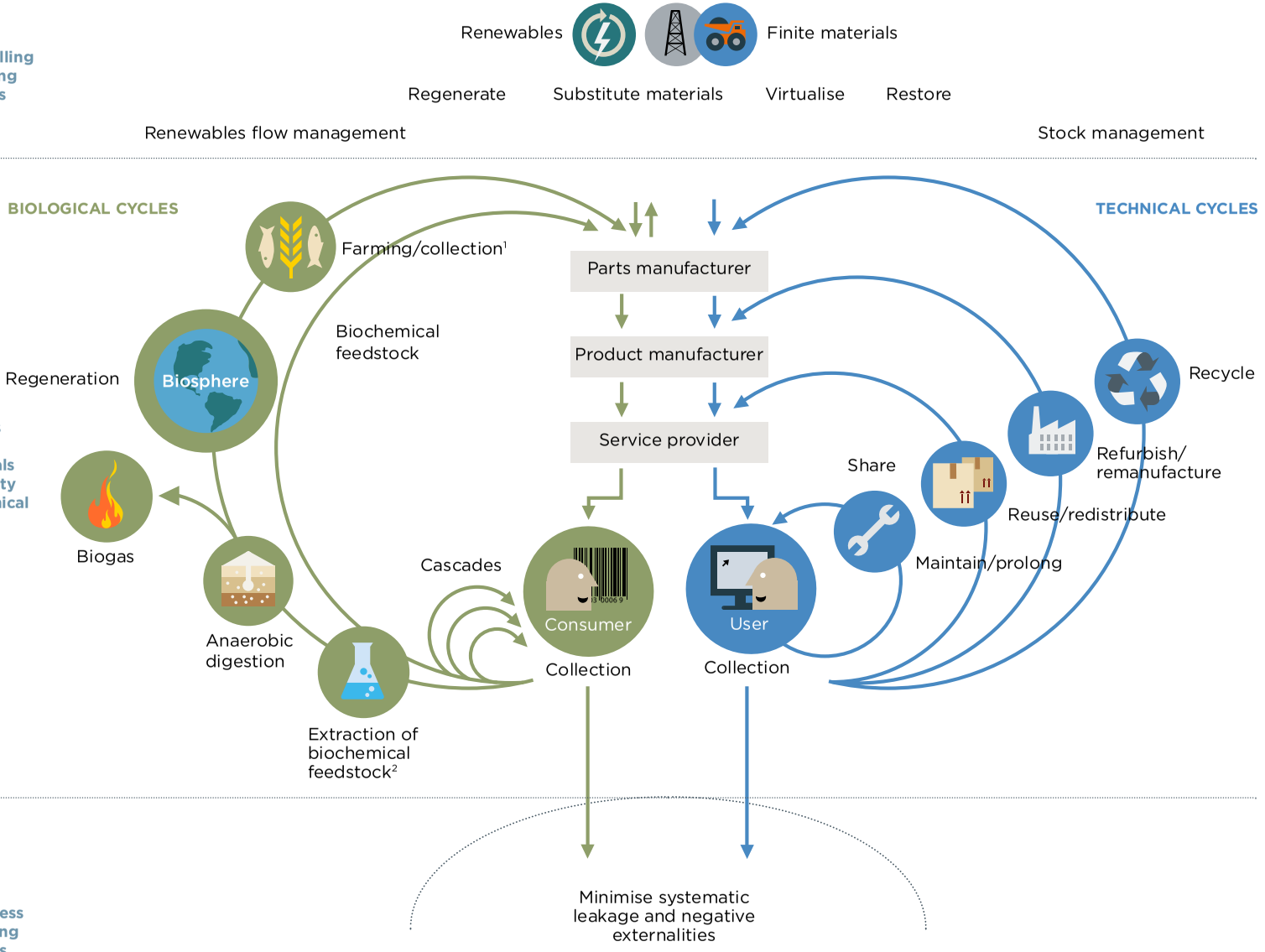
Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows

PRINCIPLE 2

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles

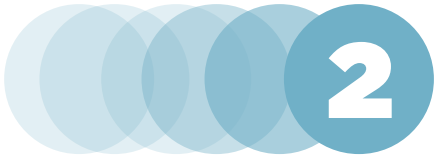
PRINCIPLE 3

Foster system effectiveness by revealing and designing out negative externalities

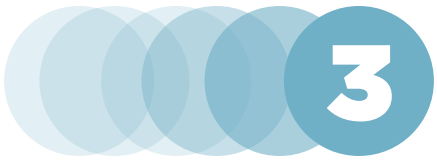


1. Hunting and fishing
2. Can take both post-harvest and post-consumer waste as an input

Source: Ellen MacArthur Foundation and McKinsey Center for Business and Environment; Adapted from Braungart & McDonough, Cradle to Cradle (C2C).



Principle 2: Optimise resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles. This means designing for remanufacturing, refurbishing, and recycling to keep technical components and materials circulating in and contributing to the economy. Circular systems use tighter, inner loops (e.g. maintenance, rather than recycling) whenever possible, thereby preserving more embedded energy and other value. These systems also maximise the number of consecutive cycles and/or the time spent in each cycle, by extending product life and optimising reuse. Sharing in turn increases product utilisation. Circular systems also encourage biological nutrients to re-enter the biosphere safely for decomposition to become valuable feedstock for a new cycle. In the biological cycle, products are designed by intention to be consumed or metabolised by the economy and regenerate new resource value. For biological materials, the essence of value creation lies in the opportunity to extract additional value from products and materials by cascading them through other applications. As in any linear system, pursuing yield gains across all these levers is useful and requires continued system improvements. But unlike a linear system, a circular one would not compromise effectiveness.



Principle 3: Foster system effectiveness by revealing and designing out negative externalities. This includes reducing damage to systems and areas such as food, mobility, shelter, education, health, and entertainment, and managing externalities, such as land use, air, water and noise pollution, and the release of toxic substances.

BOX 1 - A REGENERATIVE AND RESTORATIVE ECONOMY

A circular economy distinguishes between technical and biological cycles:

The technical cycle involves the management of stocks of finite materials. Use replaces consumption. Technical materials are recovered and mostly restored in the technical cycle.

The biological cycle encompasses the flows of renewable materials. Consumption only occurs in the biological cycle. Renewable (biological) nutrients are mostly regenerated in the biological cycle.

While the principles outlined above act as principles for action, the following fundamental characteristics describe a circular economy:



Waste is "designed out". In a circular economy, waste does not exist, and is designed out by intention. Biological materials are non-toxic and can easily be returned to the soil by composting or anaerobic digestion. Technical materials – polymers, alloys, and other man-made materials – are designed to be recovered, refreshed and upgraded, minimising the energy input required and maximising the retention of value (in terms of both economics and resources).

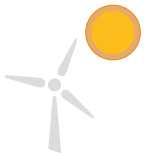


Diversity builds strength. A circular economy values diversity as a means of building strength. Across many types of systems, diversity is a key driver of versatility and resilience. In living systems, for example, biodiversity is essential to surviving environmental changes.[18] Similarly, economies need a balance of various scales of businesses to thrive in the long term. The larger enterprises bring volume and efficiency, while the smaller ones offer alternative models when crises occur.[19]

18 In agriculture, contrasting with the industrial logic of efficiency and mono-culture, recent experiments have demonstrated the benefits of leveraging biodiversity as a way to improve crop resilience. Post-organic: Leontino Balbo Junior's green farming future, August 2014, Wired.

19 Goerner, S.J., Lieater, B., Ulanowicz, R.E., Quantifying sustainability: resilience, efficiency and the return of information theory. Ecological Economics 69 (2009) 76–81

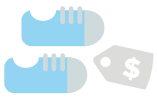
Renewable energy sources power the economy. The energy required to fuel the circular economy should be renewable by nature, in order to decrease resource dependence and increase systems resilience (to oil shocks, for example). This will be further enabled by the reduced threshold energy levels required in a circular economy.



Think in systems. In a circular economy, systems-thinking is applied broadly. Many real-world elements, such as businesses, people or plants, are part of complex systems where different parts are strongly linked to each other, leading to some surprising consequences. In order to effectively transition to a circular economy, these links and consequences are taken into consideration at all times.

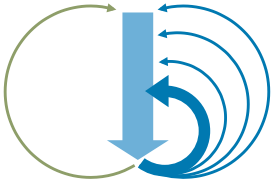


Prices or other feedback mechanisms should reflect real costs. In a circular economy, prices act as messages, and therefore need to reflect full costs in order to be effective.[20] The full costs of negative externalities are revealed and taken into account, and perverse subsidies are removed. A lack of transparency on externalities acts as a barrier to the transition to a circular economy.

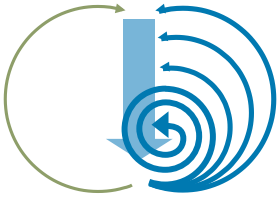


BOX 2 - THE PRINCIPLES AND FUNDAMENTAL CHARACTERISTICS OF A CIRCULAR ECONOMY ALL DRIVE FOUR CLEAR-CUT SOURCES OF VALUE CREATION.

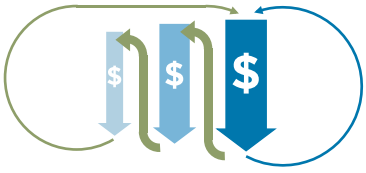
The power of the inner circle refers to the idea that the tighter the circle, the more valuable the strategy. Repairing and maintaining a product, for example a car, preserves most of its value. If this is not possible anymore, individual components can be reused or remanufactured. This preserves more value than just recycling the materials. Inner circles preserve more of a product's integrity, complexity, and embedded labour and energy.



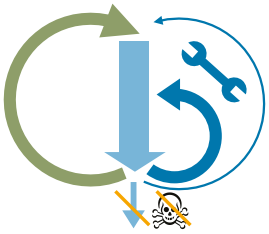
The power of circling longer refers to maximising the number of consecutive cycles and/or the time in each cycle for products (e.g. reusing a product a number of times or extending product life). Each prolonged cycle avoids the material, energy and labour of creating a new product or component. For products requiring energy, though, the optimal serviceable life must take into account the improvement of energy performances over time.



The power of cascaded use refers to diversifying reuse across the value chain, for example when cotton clothing is reused first as second-hand apparel, then crosses to the furniture industry as fibre-fill in upholstery, and the fibre-fill is later reused in stone wool insulation for construction—substituting for an inflow of virgin materials into the economy in each case—before the cotton fibres are safely returned to the biosphere.

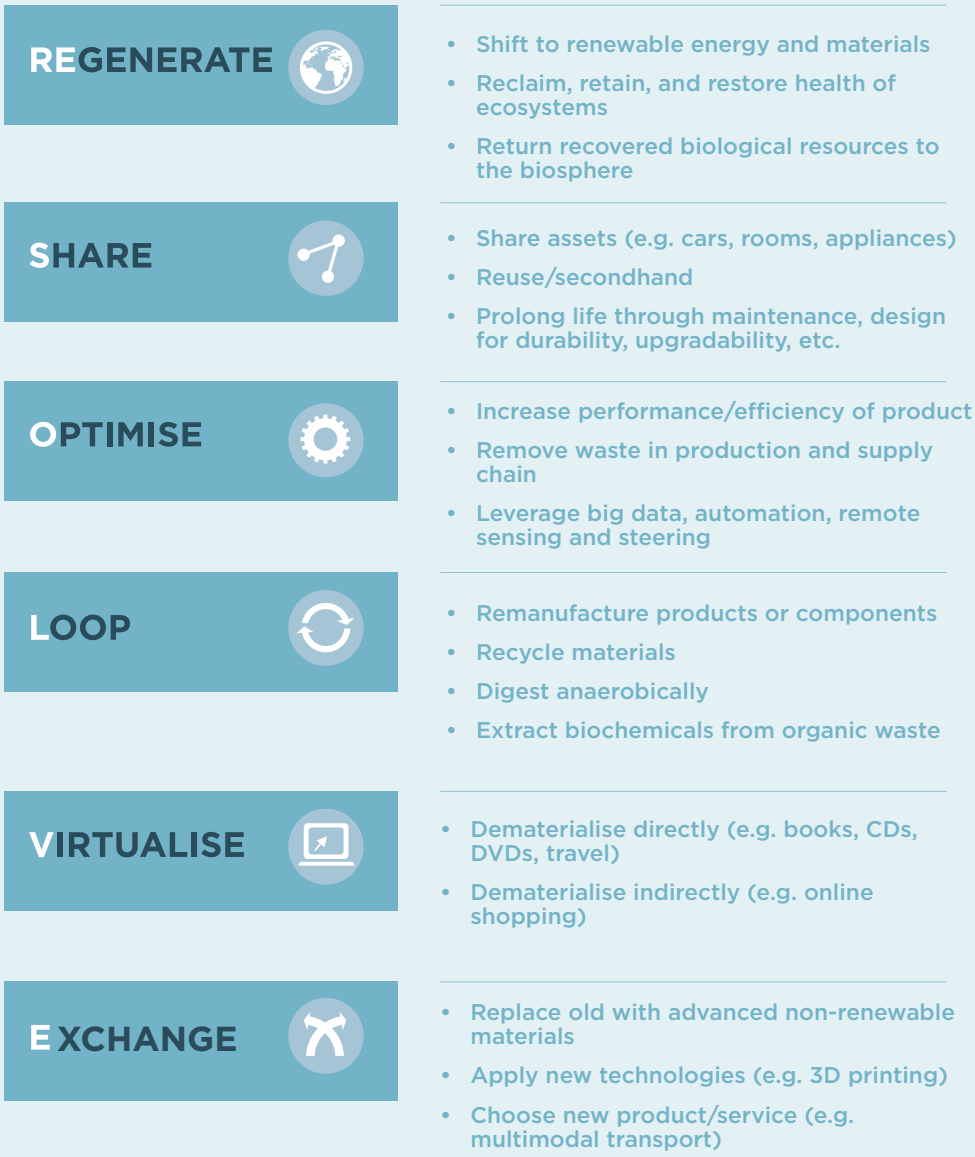


The power of pure inputs, finally, lies in the fact that uncontaminated material streams increase collection and redistribution efficiency while maintaining quality, particularly of technical materials, which in turn extends product longevity and thus increases material productivity.



20 Ken Webster, The Circular Economy: A Wealth of Flows, (2015)

FIGURE 2: RESOLVE FRAMEWORK



ASSESSING THE OPPORTUNITIES: THE RESOLVE FRAMEWORK

Through research conducted on case studies and expert interviews, the Ellen MacArthur Foundation[21] has broadly identified a set of six actions that businesses and governments can take in order to transition to a circular economy: Regenerate, Share, Optimise, Loop, Virtualise, and Exchange – together, the ReSOLVE framework. The ReSOLVE framework offers businesses and governments a tool for generating circular strategies and growth initiatives. In different ways, these actions all increase the utilisation of physical assets, prolong their life, and shift resource use from finite to renewable sources. Each action reinforces and accelerates the performance of the other actions.

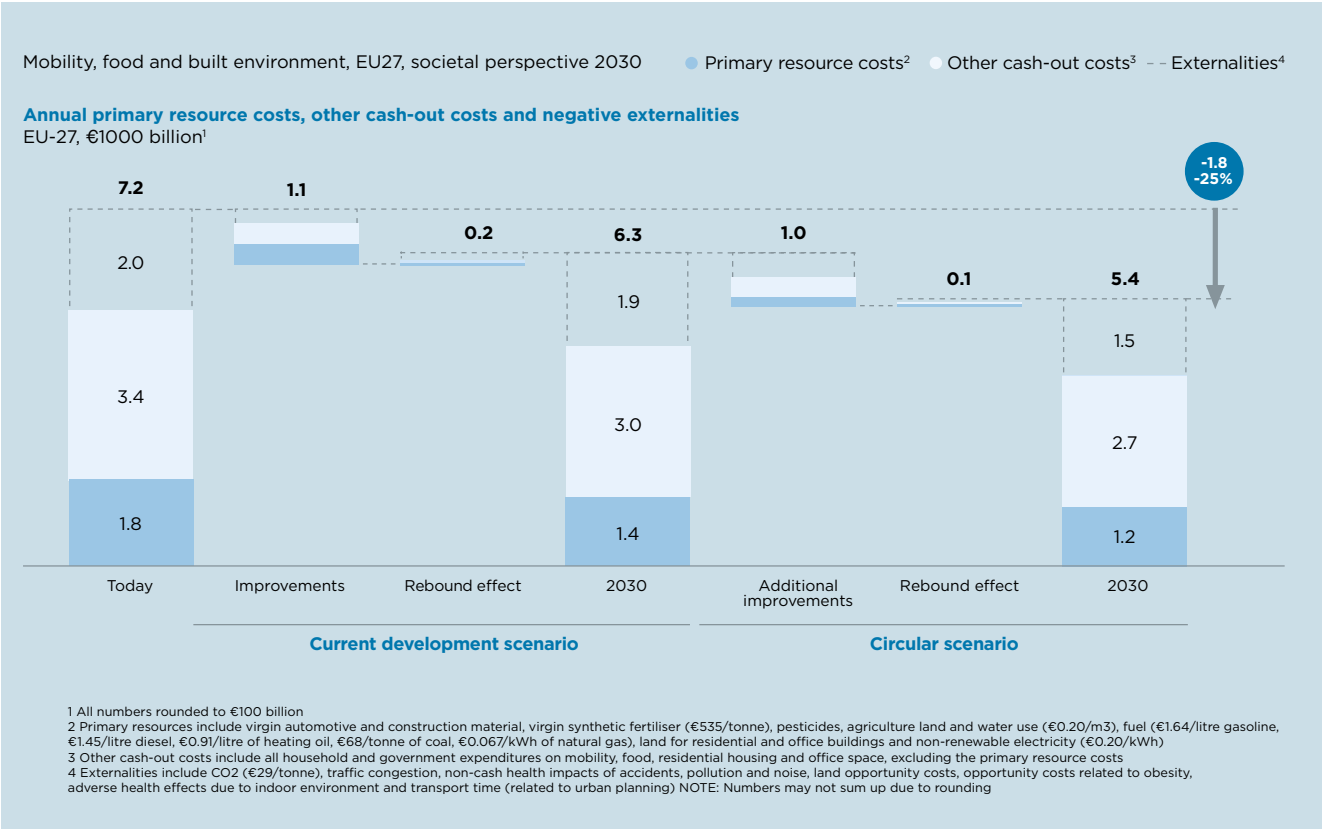
21 Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015)

SECTION 3: THE CIRCULAR ECONOMY OPPORTUNITY

The circular economy has been gaining traction with businesses and policymakers, with significant opportunities identified for both groups of stakeholders. If we transition to a circular economy, the impact will be felt across society.

The Ellen MacArthur Foundation, SUN, and McKinsey have identified that by adopting circular economy principles, Europe can take advantage of the impending technology revolution to create a net benefit of €1.8 trillion by 2030, or €0.9 trillion more than in the current linear development path. The circular economy could create tremendous opportunities for industrial renewal, regeneration, and innovation.[22]

FIGURE 3: THE CIRCULAR ECONOMY OPPORTUNITY – 2030 SCENARIOS



1 All numbers rounded to €100 billion
2 Primary resources include virgin automotive and construction material, virgin synthetic fertiliser (€535/tonne), pesticides, agriculture land and water use (€0.20/m3), fuel (€1.64/litre gasoline, €1.45/litre diesel, €0.91/litre of heating oil, €68/tonne of coal, €0.067/kWh of natural gas), land for residential and office buildings and non-renewable electricity (€0.20/kWh)
3 Other cash-out costs include all household and government expenditures on mobility, food, residential housing and office space, excluding the primary resource costs
4 Externalities include CO2 (€29/tonne), traffic congestion, non-cash health impacts of accidents, pollution and noise, land opportunity costs, opportunity costs related to obesity, adverse health effects due to indoor environment and transport time (related to urban planning) NOTE: Numbers may not sum up due to rounding

While the analysis conducted on the opportunities and impacts of a circular economy are based on European figures and assumptions, the challenges are universal, and the conclusions are directionally applicable to other regions as well.

WHAT IS THE ECONOMIC OPPORTUNITY?

Improved economic growth, substantial net material cost savings, the creation of employment opportunities, and increased innovation

22 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015). Due to the regional-specific nature of the report "Growth Within", the currency used in this instance is the Euro. Net benefits include primary resource costs, other cash-out costs, and negative externalities. In the current development path, a a technology revolution is assumed, but rebound effects and a lack of appropriate system integration do not solve resource and externalities issues.

Economic growth. Economic growth, as defined by GDP, would be achieved mainly through a combination of increased revenues from emerging circular activities, and lower cost of production through the more productive utilisation of inputs. These changes in input and output of economic production activities affect economy-wide supply, demand and prices, rippling through all sectors of the economy and resulting in a series of indirect effects that add to overall growth. Such effects include increased spending and savings resulting from an increase in household income, in turn resulting from greater remuneration to labour. Together, these effects add up to a positive change in GDP. On a circular economy development path, European GDP could increase as much as 11% by 2030 and 27% by 2050, compared with 4% and 15% in the current development scenario.[23]

Substantial net material cost savings. Based on detailed product-level modelling, the Ellen MacArthur Foundation has estimated that, in the sectors of complex medium-lived products in the EU the annual net material cost savings opportunity amounts to up to USD 630 billion in an advanced circular economy scenario.[24] For fast moving consumer goods (FMCG), we identified an additional potential of up to USD 700 billion globally.[25] In addition, sector specific analysis conducted indicates that the U.K. could save USD 1.1 billion a year on landfill costs per annum, deliver 2 GWh worth of electricity, and provide much-needed soil restoration and specialty chemicals by keeping organic waste out of landfills.[26]

Job creation potential. The Ellen MacArthur Foundation, SUN, and McKinsey supported the largest comparative study to date of the employment impacts of a circular economy transition, with 65 reviewed academic papers indicating that "existing studies point to the positive employment effects occurring in the case that the circular economy is implemented".[27] This impact on employment is largely attributable to increased spending fuelled by the lower prices expected across sectors and to the labour-intensity of high quality recycling activities and higher skilled jobs in remanufacturing. Employment opportunities would not be limited to remanufacturing and growth within large corporations; the employment story in the circular economy is rich and diverse. Jobs will be created across industrial sectors, through the development of local reverse logistics, within small and medium enterprises, through increased innovation and entrepreneurship, and a new service-based economy. In analysis conducted on Denmark, modelling suggested that ten circular economy opportunities could unlock, by 2035, 7,300–13,300 job equivalents, or 0.4–0.6% relative to a 'business as usual' scenario. In the longer term, employment often correlates with innovation and competitiveness, which should strengthen in the circular scenario.[28]

Innovation. The aspiration to replace one-way products with goods that are 'circular by design' and create reverse logistics networks and other systems to support the circular economy is a powerful spur to new ideas. The benefits of a more innovative economy include higher rates of technological development, improved materials, labour, and energy efficiency, and more profit opportunities for companies.

23 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015).

24 "Towards the circular economy", report vol. 1, Ellen MacArthur Foundation (2012).

25 "Towards the circular economy", report vol. 2, Ellen MacArthur Foundation (2013).

26 "Towards the circular economy", report vol. 1, Ellen MacArthur Foundation (2012).

27 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015).

28 "Delivering the circular economy - A toolkit for policymakers", Ellen MacArthur Foundation (June 2015).

FIGURE 4: QUALITIATIVE EMPLOYMENT EFFECTS OF A CIRCULAR ECONOMY TRANSITION



1 Includes jobs from waste management, wastewater management and recycled materials - Based on 2008 data.

Source: Eurostat; Ecorys, *Study on the competitiveness of the EU eco-industry - Within the Framework Contract of Sectoral Competitiveness Studies ENTR/06/054 - Final Report Part 1*, 2009; European Environment Agency, *Earnings, jobs and innovation: the role of recycling in a green economy*, 2011; EU Commission, *Memo: Advancing Manufacturing paves way for future of industry in Europe*, 19 March 2014.

WHAT ARE THE ENVIRONMENTAL AND SYSTEM-WIDE OPPORTUNITIES?

Reduced emissions and primary material consumption, preserved and improved land productivity, and a reduction in negative externalities

Carbon dioxide emissions. For Europe, the Ellen MacArthur Foundation found that a circular economy development path could halve carbon dioxide emissions by 2030, relative to today's levels (48% reduction of carbon dioxide emissions by 2030 across mobility, food systems, and the built environment, or 83% by 2050).[29] In addition, sector specific analysis conducted indicates that the U.K. could reduce greenhouse gas emissions by 7.4 million tonnes per annum by keeping organic waste out of landfills.[30]

Primary material consumption. A circular economy development path could result in a reduction of primary material consumption (measured by car and construction materials, real estate land, synthetic fertiliser, pesticides, agricultural water use, fuels, and non-renewable electricity) by 32% by 2030 and 53% by 2050, compared with today.[31]

29 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015).

30 "Towards the circular economy", report vol. 1, Ellen MacArthur Foundation (2012).

31 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015).

Land productivity and soil health. Land degradation costs an estimated USD 40 billion annually worldwide, without taking into account the hidden costs of increased fertiliser use, loss of biodiversity and loss of unique landscapes. Higher land productivity, less waste in the food value chain, and the return of nutrients to the soil will enhance the value of land and soil as assets. The circular economy, by moving much more biological material through the anaerobic digestion or composting process and back into the soil, will reduce the need for replenishment with additional nutrients. Systematic use of available organic waste could help regenerate land and replace chemical fertilisers 2.7 times over.[32] If Europe chose to take a circular economy approach to food systems, synthetic fertiliser consumption could fall by as much as 80% by 2050. This is the principle of regeneration at work.

Reduction in negative externalities e.g. congestion time. A circular economy would manage externalities, such as land use, air, water and noise pollution, release of toxic substances, and climate change. For example, the circular model would benefit households by reducing the cost of time lost to congestion by 16% by 2030, and close to 60% by 2050.[33]

WHAT IS THE OPPORTUNITY FOR COMPANIES?

New and bigger profit pools, greater security in supply, and new demand for business services, building greater resilience as a result

Profit opportunities. Individual businesses could achieve lower input costs and in some cases create entirely new profit streams. The Ellen MacArthur Foundation's analysis on complex medium-lived products and fast moving consumer goods showed that the use of circular economy approaches would support improvements such as the following:

- **The cost of remanufacturing mobile phones could be reduced by 50% per device[34]** – if the industry made phones easier to take apart, improved the reverse cycle, and offered incentives to return phones
- **High-end washing machines would be accessible for most households if they were leased instead of sold[35]** – customers would save roughly a third per wash cycle, and the manufacturer would earn roughly a third more in profits.
- **The U.K. could create an income stream of USD 1.5 billion annually[36]** – by processing mixed food waste discarded by households and in the hospitality sector.
- **A profit of USD 1.90 per hectolitre of beer produced can be captured[37]** – by selling brewer's spent grains.

32 "Towards the circular economy", report vol. 2, Ellen MacArthur Foundation (2013).

33 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015).

34 "Towards the circular economy", report vol. 1, Ellen MacArthur Foundation (2012).

35 "Towards the circular economy", report vol. 1, Ellen MacArthur Foundation (2012).

36 "Towards the circular economy", report vol. 2, Ellen MacArthur Foundation (2013).

37 "Towards the circular economy", report vol. 2, Ellen MacArthur Foundation (2013).

- **In the U.K., each tonne of collected and sorted clothing can generate a revenue of USD 1,975**[38] – or a gross profit of USD 1,295 from reuse opportunities.
- **Costs of packaging, processing and distribution of beer could be reduced by 20%**[39] – by shifting to reusable glass bottles

Reduced volatility and greater security of supply. The shift to a more circular economy implies using less virgin material and more recycled inputs with a higher share of labour costs, reducing a company's exposure to ever more volatile raw materials prices, increasing resilience. The threat of supply chains being disrupted by natural disasters or geopolitical imbalances is lessened, too, because decentralised operators provide alternative materials sources.

New demand for business services. A circular economy would create demand for new business services, such as:

- *Collection and reverse logistics companies that support end of life products being reintroduced into the system*
- *Product remarketers and sales platforms that facilitate longer lives or higher utilisation of products*
- *Parts and component remanufacturing and product refurbishment offering specialised knowledge*

Collection, disassembly, refurbishment of products, integration into the remanufacturing process, and getting products out to users all require specialised skills and process know-how. Most of the case examples at scale are subsidiaries of existing manufacturers, which result in new business model opportunities for incumbents.

Improved customer interaction and loyalty. Circular solutions offer new ways to creatively engage customers. New business models such as rentals or leasing contracts establish a longer-term relationship with customers, as the number of touch points increase over the lifetime of a product. These business models offer companies the chance to gain unique insights into usage patterns that can lead to a virtuous circle of improved products, better service, and greater customer satisfaction.

WHAT IS THE OPPORTUNITY FOR CITIZENS?

Greater utility as a result of more choice, lower prices, and lower total cost of ownership

Increased disposable income. Across three sectors analysed (mobility, food systems, and the built environment), it was found that a circular economy development path could increase the disposable income of an average European household through the reduced cost of products and services and a conversion of unproductive to productive time (e.g. reduction in congestion costs). The average disposable income for EU households would increase by €3,000, or 11% higher than the current development path by 2030.[40]

38 "Towards the circular economy", report vol. 2, Ellen MacArthur Foundation (2013).

39 "Towards the circular economy", report vol. 2, Ellen MacArthur Foundation (2013).

40 "Growth Within: a circular economy vision for a competitive Europe", Ellen MacArthur Foundation, SUN, McKinsey & Co. (June 2015). Due to the regional-specific nature of the report "Growth Within", the currency used in this instance is the Euro.

Greater utility. The utility or benefit felt by customers may be enhanced by the additional choice or quality that circular models provide. Customer choice increases as producers deliver systems that allow the tailoring of products or services to better meet customer needs.

Reduced obsolescence. Built-to-last or reusable products will improve budgets and quality of life. For the customer, overcoming premature obsolescence will significantly bring down total ownership costs and deliver higher convenience since they would avoid hassles associated with repairs and returns.

BOX 3 - VISION FOR A CIRCULAR ECONOMY

The opportunities of a circular economy highlighted in this section span across economies, the environment, businesses, and citizens. These benefits come together to offer a promising vision for a regenerative and restorative economy in the future. The Ellen MacArthur Foundation's latest report, *Growth Within*, laid out this vision for mobility, food systems, and the built environment, outlining what these sectors might look like in an economy based on circular principles, and the significant potential that is unlocked when we treat these key sectors as part of a broader urban system transitioning to a circular economy. Cities play a central role as motors of the global economy, with 54 per cent of the world's population living in urban areas, a proportion that is expected to increase to 66 per cent by 2050.[41] At the heart of creativity, innovation and growth, urban environments will become hotbeds of circular economic activity, enabling closed loops of biological nutrients and the recirculation of durable materials.

What does an urban environment based on circular principles look like?

The city would have a ***multi-modal mobility system*** dominated by public and shared transit. Individualised mobility would be provided as a service, and be a last-mile solution. Combined, these changes would mean fewer, better-utilised cars, with less land committed to parking and roads, and less air pollution and congestion. Citizens would have easy, convenient access to the mobility they need, while regaining access to the spaces around them. Urban planners could reclaim this unlocked, valuable inner-city land to ***integrate more natural systems into urban settings***. The built environment would evolve to offer more than just shelter, as ***buildings would generate, rather than just consume, power and food***, and in some cases be built to purify the air around them. Through vertical and urban farming, ***the city would supply much of its own food***, reusing food waste and sewage in closed and local loops to produce vegetables, fruit, and fish. ***Housing and offices would be modular, smart, and shareable***, with durable, mixed-use buildings designed in a modular way and constructed with looped and non-toxic materials. ***Infrastructure would be highly utilised***, thanks to the adoption of shared and flexible office spaces and flexible, smart, and modular homes.

41 United Nations, World Urbanization Prospects 2014 (2014)

SECTION 4: MAINSTREAMING THE CIRCULAR ECONOMY

This vision of a circular economy is gaining traction amongst government and business leaders alike as an attractive alternative to our current linear 'take-make-dispose' economy. Their imagination is captured by the opportunity to decouple economic growth from virgin resource inputs, encourage innovation, increase growth, and create more robust employment. This vision comes at a time when our global economy is poised for change. A surge in new products and sharing platforms shows that circular models of value creation do exist in pockets of the economy. The challenge now is to scale this activity to create system-level change.

The Ellen MacArthur Foundation has identified four building blocks that will help to foster a more circular economy.

Circular product design and production. A key feature of a circular economy is to be restorative and regenerative by design. The recovery of materials and products is not only addressed at end of use, but is enabled at the design level (e.g., by the choice of materials or a design for disassembly). Companies will need to build core competencies in circular design to facilitate product reuse, recycling and cascading. Circular product (and process) design requires advanced skills, information sets, and working methods that today are not readily available. Material science and selection will play a critical role in product design. Manufacturers should specify the purpose and performance of the end-products, more than those of the input materials. They should also favour pure materials in their production process since they are easier to sort at end of life. Besides material selection, other areas important for economically successful circular design are standardised components, designed-to-last products, design for easy end-of-life sorting, separation or reuse of products and materials, and design-for-manufacturing criteria that take into account possible useful applications of by-products and wastes. Circular economy business models should also be taken into account when designing products. Finally, feedback mechanisms should be developed between design and end-of-use activities.

New business models. Business models that move from ownership to performance-based payment models are instrumental in translating products designed for reuse into attractive value propositions. By prioritising access over ownership, these models drive a shift from consumers to users. Companies with significant market share and capabilities along several vertical steps of the linear value chain could play a major role in driving circularity into the mainstream by leveraging their scale and vertical integration. While many new models, materials, and products will come from entrepreneurs, these brand and volume leaders can also play a critical role. Profitable business models and initiatives will inspire other players and will be copied and expanded geographically.

Reverse cycle. A value preserving materials backbone is a core requirement for the transition to a circular economy. To create value from materials and products after their use, they need to be collected and brought back. Reverse logistics and treatment methods allow those materials to get back into the market. They will certainly include delivery chain logistics, sorting, warehousing, risk management, power generation, and even molecular biology and polymer chemistry. With cost-efficient, better-quality collection and treatment systems and effective segmentation of end-of-life products, the leakage of materials out of the system will decrease, supporting the economics of circular design. Reverse logistics chains to cascade materials to other applications will need to be optimised from beginning to end. It is therefore critical to build up the capabilities and infrastructure to move towards more circularity. Collection systems must be user-friendly, located in areas

accessible to customers and end-of-life specialists, and capable of maintaining the quality of the materials so they can cascade through diverse applications. The 'downstream' applications should cascade in ways that optimise nutrients and value recovery, before finally returning nutrients to the soil.

Enablers and favourable system conditions. While businesses can largely drive these first three building blocks, a number of enabling conditions can greatly help the transition:

- **Education.** Education can play an important role in preparing future professionals for a new economic paradigm, particularly to create the skill base to drive circular innovation. Governments should encourage the integration of circular economy and systems thinking into school and university curriculums.
- **Financing.** All players across value chains will need access to financing and risk management tools to support capital investment and R&D. A stable regulatory environment is a focal point for investors, and can be especially encouraging when governments state their intention to transition to a circular economy. Governments can create further funding stimuli by underwriting some of the risks associated with innovative business models.
- **Collaborative Platforms.** Effective cross-chain and cross-sector collaboration are imperative for the large-scale establishment of a circular system. Joint product development, IT-enabled transparency and information sharing, joint collection systems, industry standards, aligned incentives, and match-maker mechanisms could all be enabled by the establishment of collaborative platforms, across sectors or between businesses and policymakers.
- **A New Economic Framework.** Broader changes to the existing fiscal system and the measurement of economic performance could help enable a systemic transition towards the circular economy. Shifting fiscal incentives towards labour from resources, complementing today's flow-based metrics, such as GDP, with measures of a country's stock of assets, and developing a long-term plan to rebalance factor costs and adequately price key externalities, are all instruments for policymakers to develop a new economic framework that would support the transition to a circular economy.

TRANSITIONING TO A CIRCULAR ECONOMY

The strong economic rationale underlying the circular economy exhibited through the Ellen MacArthur Foundation's research allows the discussion to be reframed into one of transition speed. That speed – in turn – defines the costs of the transition. Transition costs may comprise asset investments or investment in new digital infrastructure, R&D, retraining, support to promote market penetration of new products, or transitory support for affected industries. Accelerating the adoption of the circular economy to a rate higher than normal replacement cycles will increase these transition costs and create stranded assets. It remains to be assessed to what extent these costs are additional relative to other development scenarios and to what extent they could act as stimulus to stagnating economies.

There are certainly risks to be considered in a systemic transition such as this. Incumbent industries will have to adapt their business models, and moving to these business models could create redistributive effects in the economy. Balancing the redistributive effects of the changes that the realisation of a circular economy might produce for consumers, businesses, and nations will be crucial.

WHY NOW?

Our economy is currently locked into a system in which everything from production economics and contracts to regulation and the way people behave favours the linear model of production and consumption. However, this lock-in is weakening under the pressure of several powerful disruptive trends. We must take advantage of this favourable alignment of economic, technological, and social factors in order to accelerate the transition to a circular economy. Circularity has started to make inroads into the linear economy and has moved beyond the proof of concept; the challenge we face now is to mainstream the circular economy, and bring it to scale.

About the Ellen MacArthur Foundation

The Ellen MacArthur Foundation was established in 2010 with the aim of accelerating the transition to the circular economy. Since its creation the charity has emerged as a global thought leader, establishing circular economy on the agenda of decision makers across business, government and academia. The charity's work focuses on four interlinking areas:

Education: Inspiring learners to re-think the future through the circular economy framework

We are creating a global teaching and learning platform built around the circular economy framework, working in both formal and informal education. With an emphasis on online learning, the Foundation provides cutting edge insights and content to support circular economy education and the systems thinking required to accelerate a transition.

Business and Government: Catalysing circular innovation and creating the conditions for it to flourish

Since our launch, we've emphasised the real-world relevance of our activities and understand that business innovation sits at the heart of any transition to the circular economy. The Foundation works with Global Partners (Cisco, Google, Kingfisher, Philips, Renault, and Unilever) to develop circular business initiatives and to address challenges to implementing them.

Insight and Analysis: Providing robust evidence about the benefits of the transition

We work to quantify the economic potential of the circular model and develop approaches for capturing this value. Our insight and analysis feeds into a growing body of economic reports highlighting the rationale for an accelerated transition towards the circular economy, and exploring the potential benefits across different stakeholders and sectors.

Communications: Engaging a global audience around the circular economy

The Foundation communicates cutting edge ideas and insight t§hrough its circular economy research, reports, case studies and books disseminated through our publications arm. We utilise new and relevant digital media to reach audiences who can accelerate the transition, globally. In addition, we aggregate, curate, and make knowledge accessible through Circulate, an online location dedicated to providing up to date news and unique insight on the circular economy and related subjects.

APPENDIX: THE CIRCULAR ECONOMY IN PRACTICE – BUSINESS CASE STUDIES AND POLICY EXAMPLES

Research to date by the Ellen MacArthur Foundation has provided ample evidence that circularity has started to make inroads into the linear economy and that it has moved beyond the proof of concept – a number of businesses are already thriving on it, and policymakers are recognising the circular economy potential to enable key policy objectives. Innovative products and contracts designed for the circular economy are already available in a variety of forms – from innovative designs of materials and products (e.g., biodegradable food packaging and easy-to-disassemble office printers) to pay-per-use contracts (e.g., for tyres). Demonstrably, these examples have in common that they have focused on optimising the total system performance rather than that of a single component.

The Ellen MacArthur Foundation has developed a number of business and policy case studies that show a circular economy in practice, a selection of which are published on our website.

http://www.ellenmacarthurfoundation.org/case_studies/

For policy related case studies, please refer to one of the Ellen MacArthur Foundation's latest reports, *Delivering the circular economy – A Toolkit for Policymakers.*

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