

PART ONE

An overview of the circular economy

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The circular economy

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What is it?

*Every few hundred years in Western history there occurs a sharp transformation. Within a few short decades, society – its world view, its basic values, its social and political structure, its arts, its key institutions – rearranges itself. Fifty years later there is a new world.*¹ PETER F DRUCKER

The famed business consultant Peter Drucker, writing in 1992, went on to say: ‘And the people born then cannot even imagine the world in which their grandparents lived and into which their own parents were born.’

In recent decades, we can see many transformational changes in the way we live, work and communicate. The linear economy that emerged from the early Industrial Revolutions, based on take, make and waste, is being replaced by the circular economy. Companies will rethink how they design laptops, furniture, sneakers, cars, mobile phones, cleaning products and even jeans. Instead of selling and forgetting products, companies will use products as opportunities for continuous value creation and profitable, long-term customer relationships.

Stahel (2016) and others describe different business models in the circular economy.² I do not own a mobile phone, instead I lease it from a company that has designed it to be upgradeable, customizable and easy to repair or remanufacture. I no longer buy electric lights, I buy LED lighting as a service, and the company selling that lighting service ensures those LED lamps work reliably for a very long time.

Businesses large and small, around the world – established global corporates, and disruptive start-ups – are innovating business models and product design, aiming to capitalize on the fantastic opportunities to trade with the rapidly growing ‘consumer classes’, secure access to future resources, and ‘future-proof’ their businesses.

We review the issues arising from our traditional ‘linear’ economy in Part 2, but first we explore the circular economy in more depth, looking at:

- the background to the circular economy;
- evolution of the concept: main schools of thought, their principles and how these compare;
- a brief look at some supporting approaches;
- scaling it up: a selection of business groups and companies investing in it;
- a generic framework, which we explore in more detail in Chapters 2 to 4.

Background

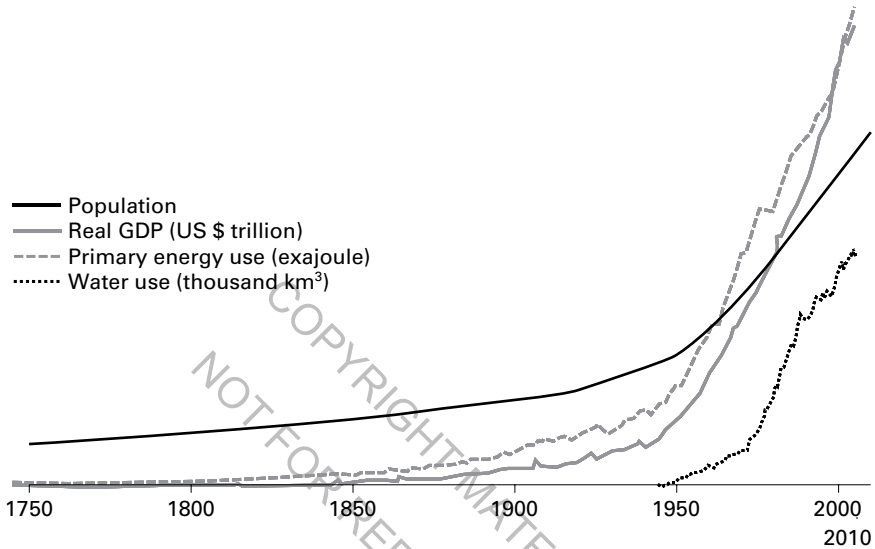
From the 1970s onwards there has been increasing realization that many of the resources we rely on for our survival are either finite or are constrained by the speed of renewal, or availability of land. In our urban environments it is easy to forget that the earth and its living systems provide everything we use or consume – our food, air, water, housing, clothes, transport – everything.

Rachel Carson, in her book *Silent Spring* (1962), raised public awareness of the environment and destruction of wildlife through widespread use of pesticides.³ The press condemned her, and the chemical industry even tried to ban the book. Since the 1950s, agricultural practices have changed in many developed nations, using synthetic fertilizers and irrigation to achieve massive increases in crop yields. Alongside this, human population continued its exponential growth path, with increasing numbers of people and levels of consumption. In the 20th century, whilst population quadrupled, *gross domestic product (GDP)* and consumption increased by a factor of 20. Many other indicators of consumption and development show the same exponential upward trend from the 1950s, with Figure 1.1 showing some examples of the ‘Great Acceleration’. As the effects of the ‘Great Acceleration’ began to emerge, scientists and institutions began to question our ‘traditional’ ways of selling and consuming products. You can see more on the World Economic Forum website.⁴

Economist and systems theorist Kenneth Boulding (1996) described the issues of open and closed systems in relation to economics and resources.⁵ He speculates whether the first factor to limit growth would be running out of places to store our waste and pollution, before we ran out of raw materials to use. ‘Los Angeles has run out of air, Lake Erie has become a cesspool, the oceans are getting full of lead and DDT, and the atmosphere may become man’s major problem in another generation, at the rate at which we are

filling it up with gunk.’ He advocated focusing on maintaining our resource stocks and encouraging technological change that reduced production and consumption.

Figure 1.1 The Great Acceleration



SOURCE: Stockholm Resilience Centre [Online] <http://stockholmresilience.org/21/research/research-news/1-15-2015-new-planetary-dashboard-shows-increasing-human-impact.html/>

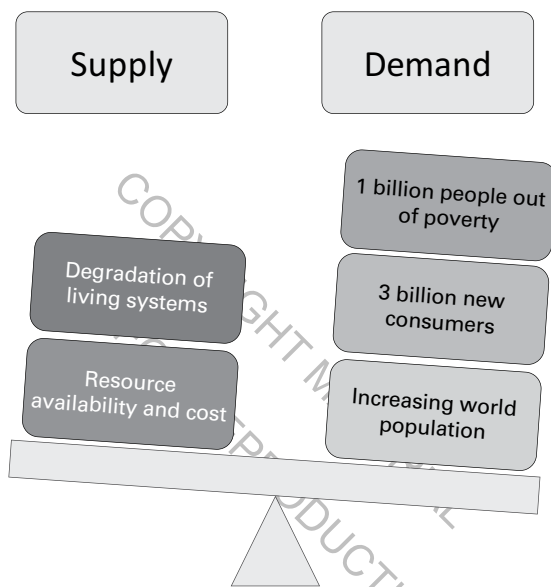
As we improved techniques for mining, extraction and manufacturing, resource costs declined steadily, despite some short-term increases resulting from wars and geopolitical factors. Over the 20th century, prices halved. As we moved into the 21st century, a tipping point occurred, and the declining trend became a steep upward trajectory that consultants McKinsey (2011) described as a ‘century of price declines, reversed in a decade’.⁶ We have found, and used, all the ‘easy to get at’ stuff. Worse still, prices are at their most volatile since the ‘oil shock’ of the 1970s, and frequently a shock in one resource flows through to others.

Predictions show a step-change in global demand between 2010 and 2030, as 3 billion new consumers join the ‘middle classes’, earning enough income to purchase a mobile phone, more processed food and meat, better housing and maybe even to take holidays abroad.

This rapid growth in demand, plus the difficulties of finding cost-effective sources of materials and meeting environmental challenges, puts a further squeeze on the cost of supply. We still have a major challenge with inequality

and poverty too, with over 1 billion people lacking secure access to food, water and energy. Figure 1.2 highlights the tipping point we have reached. The increasing pressures of demand, coupled with challenges for supply of resources, and the health of the living systems we depend on for clear air, safe water, food, timber, pollination and medicine, mean we need to rethink our systems. We explore this further in Part 2.

Figure 1.2 Tipping point



Reports in recent years from the United Nations, the European Commission, the OECD, the World Economic Forum and global management consultancies have echoed the strong warnings published in the Club of Rome's report *Limits to Growth* (1972).⁷ They share concerns about the combination of overexploitation of important *ecosystems* and natural resources, an increasingly unstable climate, and pollution of air, water, soil and the atmosphere.

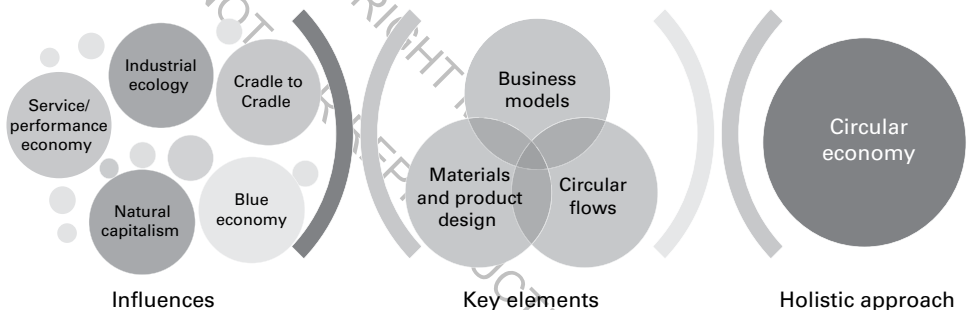
The way we make things is contributing to the problem. Most manufacturing methods are 'linear' – the company takes some materials, makes a product and sells it to the consumer, who discards it when it is no longer required. It is sometimes described as a 'throughput' or even a 'waste' economy, with waste created at the end of life, and during the manufacturing process. This waste is damaging our living systems (which provide our clean air, climate control, clean water and healthy soil) and depleting our resources. We return to these, later in the book.

Evolution of the concept: architects, scientists and sailors

So how did the circular economy evolve? In the latter part of the 20th century, leading thinkers developed new concepts for sustainable business models. New jargon is appearing in business publications, including *cradle to cradle*, *biomimicry*, *ecosystem services*, *design for disassembly*, *industrial ecology* and *upcycling*. A recurring concept is the ‘circular economy’ model.

Here, we examine the different schools of thought, shown in Figure 1.3, looking at how they prioritize different aspects and outcomes, before amalgamating them into the circular economy framework used throughout this book.

Figure 1.3 Evolution of the circular economy



The performance economy

Walter Stahel’s Product-Life Institute outlines its main objective as ‘to open new frontiers of economic development towards a Performance Economy (or Functional Service Economy), which focuses on selling performance (services) instead of goods in a circular economy, internalizing all costs (closed loops, cradle to cradle)’.⁸ It believes this will be achieved by combining system design, technical and commercial innovation – mainly within regional economies, developing business models of remarketing goods (reuse), and extending the product life of goods and components (eg through remanufacturing and upgrading) to create local jobs, increase ‘resource husbandry’ and prevent waste.

Five 'pillars' support the vision of the sustainable economy and society:

- 1 Nature conservation:** nature and living systems provide the foundation for human life. We depend on resources 'supplied by the global eco-support system' such as biodiversity, forests, clean air, rivers and oceans. The 'carrying capacity of nature' links to the regional populations and their lifestyles, eg water use, land-use patterns, pollution and waste assimilation.
- 2 Limiting toxicity:** thus protecting the health and safety of humans and other living species. Examples here include toxic agents such as heavy metals, pesticides, process chemicals and so on. This requires precise measurements (eg in nanograms) and assessment of nature's capacity to absorb and process these toxins.
- 3 Resource productivity:** with industrialized countries reducing their material use, or 'dematerializing', so other countries can develop. Stahel estimates that we need to reduce resource consumption by a factor of 10, to prevent the threat of a radical change at planetary level and support reduced inequality between nations.
- 4 Social ecology:** Stahel highlights the importance of peace and human rights, race and gender equality, dignity and democracy, employment and social integration, security and safety.
- 5 Cultural ecology:** including education and knowledge, ethics, culture, values of 'national heritage' and attitudes towards risk.

Natural capitalism

Natural Capitalism: Creating the next Industrial Revolution (1999), written by Paul Hawken *et al*, describes a blueprint for a new economy.⁹ It imagines a new industrial revolution, where environmental and business interests overlap, and companies can simultaneously improve profits, help solve environmental problems and feel positive about their impacts. It sees that the key driver for previous industrial revolutions was human productivity, whereas now people and technology are abundant, but natural capital is diminishing.

Natural capital encompasses both natural resources and ecological systems, providing vital life-support services to all living things. It may be difficult, or impossible, to substitute these services. For pollination services, provided by bees and butterflies, the prospect of hand or robot pollination quickly raises big questions: how – and how expensive? The authors point

out that current business practices typically ignore the value of these services and natural assets, even though this value is increasing in line with their scarcity. Our wasteful use of energy, materials, fibre, soil and water is degrading and depleting natural capital.

Natural capitalism has four principles:¹⁰

- 1 Increase the productivity of natural resources.** Innovations in production design and technology can stretch natural resources – energy, water, forests, minerals – five, 10 or even 100 times further than today. Crucially, the financial savings can help companies to implement the other three principles.
- 2 Use ‘biologically inspired’ production models and materials.** Closed-loop systems, modelled on nature, mean that every output is either returned to nature as a nutrient (waste = food), or becomes another manufacturing input. Design industrial processes to reduce dependence on finite inputs and mimic the benign chemistry of nature. The results are often elegantly simple products, made using vastly more efficient production methods.
- 3 ‘Service and flow’ business models.** These deliver value as a continuous flow of services, such as providing illumination instead of selling light bulbs. In these models, providers and customers share the same objectives, and both share rewards through resource productivity and product longevity.
- 4 Reinvest in natural capital.** Depleting capital erodes the basis of future prosperity. Using up (and throwing away) finite resources means those resources are no longer available. Polluting water sources destroys sources of drinking water, fish and destroys species. As our human population and needs increase, there is more pressure on our natural capital. Consumers are becoming more aware of these issues, and so there is pressure on business to restore, maintain and increase natural capital. This creates major opportunities for business.

Natural capitalism emphasizes the importance of ‘whole system design’, adapting innovative technologies and rethinking ‘defective practices’ in the way companies allocate capital and governments set policy and taxation.

Industrial ecology

Preserving materials and energy ‘embedded’ in a product – raw materials, energy, water and other process aids – is a basic tenet of industrial ecology.¹¹ Industrial ecology aims to help businesses in their understanding of how

they use key resources, track material, energy and water flows, and how to account for a product throughout its life cycle. It aims to change resource use from being implicit to explicit, from the beginning of the cycle to the end of use.

What a country consumes, rather than what it produces, is a key indicator of a country's environmental impact. Although recycling helps reduce energy, preserve resources and reduce environmental impact, we must change what and how we consume. Traditional models of industry, 'take, make and dispose', should be transformed into 'industrial ecosystems', optimizing consumption of energy and materials, minimizing waste and ensuring that effluents from one process become the raw materials for another.

Blue economy

Gunther Pauli's 'Blue Economy' (2015) bases its solutions on physics, using nature's systems of cascading nutrients, matter and energy as the ideal model.¹² Gravity is the main source of energy, solar energy is the second renewable fuel and water is the primary solvent. Nature does not need complex, chemical, toxic catalysts, and everything is biodegradable – it is just a matter of time.

In the blue economy, waste does not exist, and any by-product can be the source for a new product. Question the use of all materials used in production – can you manage without it? Can you do more with less?

The blue economy business model has two themes: 1) substitute something with nothing; 2) cascading nutrients and energy.¹³ The blue economy sees that our current economic model relies on scarcity as a basis for production and consumption. It defines 'wealth' as diversity, and our industrial standardization is the opposite.

Nature evolved from a few species, is continuing to evolve every moment, and change is a constant. Nature is non-linear. Nature uses what is locally available, responds first to basic needs and then evolves from sufficiency to abundance and symbiosis – in natural systems, everything is interconnected and one process generates multiple benefits.

Sustainable business maximizes use of available material and energy, so reducing the unit price for the consumer. Sustainable business respects local resources, culture and tradition.

Pauli reminds us that in nature there is water, air and soil available to all, free and abundant. Sustainable societies 'Respond to basic needs with what you have, introducing innovations inspired by nature, generating multiple benefits, including jobs and social capital, offering more with less.'

The blue economy is now part of the Zero Emissions Research and Initiatives (ZERI). This has high aims: to create 100 million jobs and substantial capital value through 100 innovations in the decade 2010–20. All innovations are *open sourced* and published on the Blue Economy website (www.theblueeconomy.org).

Cradle to cradle

William McDonough and Dr Michael Braungart wrote *Cradle to Cradle: Remaking the way we make things* (2002), describing the importance of treating materials as biological or technical nutrients and extending the ‘use period’ for all these materials. McDonough and Braungart encourage a systems-thinking approach, reframing design to be regenerative, and constantly progressing from being ‘less bad’ to doing ‘more good’. It rejects the idea that growth is bad for the environment, reminding us that, in nature, growth is good.

Instead of ‘eco-efficiency’, it aims for ‘eco-effectiveness’, driving innovation and leadership towards positive goals. Eco-efficient, demand-side approaches may only reduce or minimize damage; eco-efficiency is simply sensible business practice. This means setting a design brief to include positive impacts on economic, ecological and social health. The brief should focus on supply-side approaches and include Cradle to Cradle™ values and principles. Good design outcomes include fun, beauty and inspiration; and encourage healthy, abundant environmental outcomes.

Their website summarizes the Cradle to Cradle™ principles:¹⁴

- **material health:** value materials as nutrients for safe, continuous cycling;
- **material reutilization:** maintain continuous flows of biological and technical nutrients;
- **renewable energy:** power all operations with 100 per cent renewable energy;
- **water stewardship:** regard water as a precious resource;
- **social fairness:** celebrate all people and natural systems.

The ‘Cradle to Cradle Certified™ Product Standard’ is managed by the Cradle to Cradle Products Innovation Institute, an open-sourcing, non-profit organization.¹⁵ This is a continual improvement process, assessing a product against the five principles listed above, and with a range of achievement levels to support continual improvement.

Circular economy

The circular economy is becoming synonymous with the work of the Ellen MacArthur Foundation (EMF). EMF is a charity working with businesses, governments and education to accelerate the transition to a circular economy, and publishes many of the recent books, papers and videos explaining and promoting it. The foundation works closely with consultants McKinsey and with a wide range of global businesses, which form its ‘CE100’ group. Many of the leading thinkers mentioned in the other circular approaches also support the EMF, providing online articles, lectures and so on.

The first major report in the ‘Towards the Circular Economy’ (2012) series broke new ground, calculating the economic and business opportunities for a restorative, circular model.¹⁶ The circular economy takes its inspiration from nature, where one species’ waste is another’s food, and the sun provides energy. A circular economy ‘cycles valuable materials and products and produces and transports them using renewable energy’.¹⁷

Principles:

- 1 Waste = food:** in living systems, there is no such thing as ‘waste’ – one species’ waste becomes food for another species. A dead rabbit is eaten by predating animals or birds, and becomes nutrients for the soil. We can reduce waste by redesigning products so they can be reused or disassembled at the end of life, keeping the products and their materials at their highest value at all times.
- 2 Build resilience through diversity:** this principle uses nature as a model, explaining that living systems are diverse, with many, many different species helping to support the ecosystem against shock (eg drought, floods). Nature has a wide pool of resources and can share strengths, building up the overall health of the system and creating resilience. Companies, nations and economic systems can use diversity to build resilience and resources.
- 3 Use renewable energy:** the circular economy is about many actors working together, creating effective flows of both materials and information, with everything increasingly powered by renewable energy.
- 4 Think in systems:** looking at the connections between ideas, people and places to create opportunities for people, planet and profit.

EMF describes four ‘building blocks’ for the circular economy:¹⁸

- 1 Circular economy design:** product and system design needs a different approach, to enable product reuse, recycling and ‘cascading’ (waste from

one process becomes an input for another). This means advanced skills, information and methodologies. Focus areas include material selection, and standardized or modular components. Design should aim for durability, easy end-of-life reuse, sorting or separation of products and materials, and look for potential by-products and uses for ‘waste’.

- 2 New, innovative business models to replace existing ones or seize new opportunities: major companies can use their scale and vertical integration to help drive circularity into the mainstream. In addition to the ideas, materials and products will come from disruptors and start-ups; brand and volume leaders can inspire other players and help accelerate the transition.
- 3 Reverse cycles: new material and product cascades and the final return of materials to the soil or back into the industrial production system needs careful thinking and new approaches. This includes logistics, storage, risk management, power generation and even molecular biology and polymer chemistry. Systems for end-of-life products must provide effective and efficient collection, sorting, treatment and segmentation, reducing ‘leakage’ of materials out of the system and so supporting the business case for circular design.
- 4 Enablers and favourable system conditions: new or revised market mechanisms can encourage widespread reuse of materials and higher resource productivity. Policymakers, educational institutions and popular-opinion leaders will all need to support these. Examples include collaboration; new incentives; providing a suitable set of international environmental rules; leading by example and scaling up rapidly; and access to financing.

We compare these schools of thought later in this chapter, highlighting the different priorities in their approaches.

Other supporting approaches

Approaches such as biomimicry, permaculture and The Natural Step (www.thenaturalstep.org) have developed alongside circular economy schools of thought, and can help solve specific problems, to provide a different outlook on linear economy problems, or enrich circular economy solutions:

- **Biomimicry**, as defined by the Biomimicry Institute, is ‘an approach to innovation that seeks sustainable solutions to human challenges by emulating nature’s time-tested patterns and strategies’.¹⁹

- **Permaculture** originated in the 1970s, designing ways to mimic natural forest ecosystems, mainly with tree crops, to create perennial agroforestry, or ‘permanent agriculture’ systems. It developed into a system-thinking tool for designing low input, productive landscapes, enterprises, buildings and communities.
- **The Natural Step** is a global network of non-profit organizations, focusing on sustainable development using a science-based framework.²⁰ Its mission is to accelerate the transition to a sustainable society: ‘in which individuals, communities, businesses and institutions thrive within nature’s limits’.

We see examples of these approaches throughout this book.

Scaling it up: companies, think tanks, business groups

Forward-thinking organizations and businesses are adopting circular approaches, moving away from our ‘take, make, waste’ systems towards holistic systems. They aim to retain valuable resources, regenerate or at least do no harm to living systems (that provide our essential services), and balance the needs of humanity with the constraints of our living planet. The World Economic Forum (WEF), the European Union (EU) and China are among those researching, investing and promoting the circular economy.

World Economic Forum

In 2014, the WEF, supported by research and ideas from the Ellen MacArthur Foundation and McKinsey, launched its circular economy ‘scaling up’ initiative, Project MainStream.²¹ Chief executive officers (CEOs) of nine global companies – Averda, BT, Tarkett, Royal DSM, Ecolab, Indorama Ventures, Philips, SUEZ and Veolia, lead the project. It focuses on: 1) systemic stalemates in global material flows that are too big or too complex for an individual business, city or government to overcome alone; 2) circular economy ‘enablers’ – for example, digital technologies.

European Union

The EU announced its circular economy action plan, ‘Closing the Loop’, in December 2015.²² It sees the transition to a more circular economy as an

essential contribution towards a sustainable, low-carbon, resource-efficient economy, generating new and sustainable competitive advantages for Europe. This includes maintaining the value of materials, resources and products in the economy for as long as possible and minimizing waste. A circular economy can protect businesses against resource scarcity and price volatility, so creating opportunities for innovative, efficient methods of production and consumption. This includes creating local jobs, opportunities for social integration, saving energy and avoiding irreversible damage from consuming resources faster than the earth's capacity for renewal. The EU recognizes that businesses and consumers are key in driving the circular economy, and that it must play a fundamental support role. This will include regulatory frameworks and signals on the way forward, with ambitious, broad and concrete actions before 2020.

China

The first stage of China's circular economy began in 1998, starting with conceptual studies by academics.²³ The second stage included clean production and eco-industrial parks, supported by an increasing government environmental protection department. The third stage, starting in 2006, saw the circular economy presented as an alternative development model. A circular economy 'promotion law' aims to decouple economic growth from resource consumption and pollutants, and to help China leapfrog to a more sustainable economic structure.

Global consultants

Of the major global management consultancy businesses, McKinsey & Company is probably the most active in the circular economy. It has published several papers, is knowledge partner to the EMF, and provides research and insight for many of the EMF and WEF reports.²⁴ PwC includes 'circular economy solutions' as part of its Sustainability Services, and is involved in the RSA Great Recovery project.²⁵ It has published white papers and blogs on aspects of the circular economy.

Accenture published an infographic (2013)²⁶ and a report (2014)²⁷ highlighting 'leading organizations adopting circular economy models to decouple growth from scarce resources'. It is involved in research programmes, and working with the WEF, Young Global Leaders Forum and others, exploring the transition and transformation required to create a circular economy.

Leading global businesses are also making significant investments in the circular economy, working out ways to gain value from their process and end-of-life waste.

Renault: recycling and remanufacturing

Renault's corporate 'blog' (2015) 'Circular economy: re-cycle, re-use, Re-nault!' describes the circular economy as 'the ultimate recycling programme, where ideally nothing goes to waste'.²⁸ Examples of its progress so far include:

- By 2014, the Renault Espace car was 90 per cent recyclable.
- All cars in the 2014 range included 30 per cent recycled materials.
- Renault's French factory, Choisy-le-Roi, *remanufactures* parts, including gearboxes containing around 75 per cent pre-used parts, and engines with 38 per cent pre-used parts.
- The French factory uses remanufactured parts exclusively for repairing in-use vehicles, testing all parts to ensure quality and performance.
- Remanufacturing began at Choisy-le-Roi in 1949, and the expanded range of components includes injectors, injection pumps and turbo-compressors.²⁹
- Renault is also investing in car recycling with its subsidiary INDRA, dismantling end-of-life vehicles to access spare parts, thus enabling recycling of components and materials.

Philips: service and performance

Philips views the 'transition from a linear to a circular economy as a necessary boundary condition' for a sustainable world.³⁰ Circular innovations in material, component and product reuse, as well as new business models based on solutions and services, create value by reducing costs and growing markets.

Philips highlights some global trends, presenting both challenges and opportunities:

- Costs and availability of resources: the ‘end of the era of cheap oil and materials’ means that using less is not enough, and business faces risks from price volatility.
- Expansion of the ‘middle class’, with another 3 billion people, mainly from emerging economies, joining the middle classes by 2030 and driving demand (and thus waste).
- ‘Big data’ providing deeper levels of market intelligence and understanding of consumer behaviour, and transforming the scale and approach of solving problems. Big data helps understand where things are in the economy, what they consist of and their condition or status.
- New and sharpened legislation and governance, in response to toxic materials, waste to landfill and other challenges. Companies are responding with innovations in product design and materials.
- Changing models of consumption, as consumers prioritize access and performance over ownership.
- Relationships replace transactions. Social media and multichannel commerce is increasing the engagement and connections between brands and consumers.

Philips provides examples of its circular economy developments, including its Diamond Select Advance system, offering pre-owned, refurbished health-care products such as MRI scanners. A well-publicized example is its ‘pay per lux’ LED lighting solution, whereby Philips offers light as a service and retains responsibility for the performance of the lighting.

H&M: circular recovery flows

Global fashion brand H&M created its ‘closing the loop’ initiative, building on the trends for vintage and retro clothing: ‘We’ll literally turn your old clothes into new garments to avoid fashion going to waste.’³¹ The concept is to collect, reuse and turn clothing into something new. They claim that it is the quickest, easiest way for the fashion industry to reduce significantly its consumption of resources and landfilled waste. H&M has already set up a Garment Collecting programme and can blend about 20 per cent of recycled fibres into new yarns.

IKEA: use less, use renewables, use it more, use it again

Speaking at a *Guardian* (2016) conference, Steve Howard, IKEA's head of sustainability, said:

If we look on a global basis, in the West we have probably hit peak stuff. We talk about peak oil. I'd say we've hit peak red meat, peak sugar, peak stuff... peak home furnishings... We will be increasingly building a circular IKEA where you can repair and recycle products.³²

In IKEA's 'People and Planet Positive' Strategy,³³ two of the three strands have circular economy themes:

- 'Inspire and enable millions of customers to live a more sustainable life at home.' IKEA aims to develop and promote products and solutions that help customers to save or generate energy, recycle or reduce water use, and sort or reduce waste. Examples include switching the entire lighting product range to LED lighting in 2015. LED lights use up to 85 per cent less energy than incandescent lighting, and LED bulbs can last up to 20 years. All IKEA's kitchen taps include features that restrict the water flow, reducing water use by up to 40 per cent. Bathroom taps now include energy-saving cold-start functions.
- 'Strive for resource and energy independence.' IKEA recognizes the importance of securing long-term access to sustainable raw materials, aspiring to have a positive impact on those communities where it sources raw materials. IKEA aims to use resources within the earth's limits, drive energy efficiency across its value chain and produce renewable energy to balance its consumption. For products sourced from forests, by 2015 IKEA was sourcing 50 per cent of its wood from sustainable sources (either *Forest Stewardship Council (FSC)* certified, or recycled), and by 2020 it plans to expand this to include 100 per cent of wood, paper and cardboard. By 2015 IKEA will source all its cotton from more sustainable sources (including the Better Cotton Initiative and the e3 Cotton Programme).

IKEA's report describes the company 'converting to a circular economy... where waste is eradicated in a cycle of repair, reuse, refurbishment and recycling'.³⁴ It sees closing the loop as having huge potential to make positive impacts, whilst presenting a big challenge.³⁵ A circular IKEA means focusing on:

- Designing products for circularity: prolonging product life, designing for ease of upcycling and recycling, and providing customers with clear, simple solutions for repairing and reusing home furnishing products. Used products will become ‘banks of materials’ for the future.
- The supply chain will become a resource chain, improving the ability to use secondary materials (recovered from post-use products), so increasing demand and availability and using more recycled materials to stimulate the recycling industry.
- New options for renting, sharing or reselling products: analysing listings of its pre-owned products on eBay and finding around 80,000 for sale at any one time, IKEA realized its customers were finding value in a second-hand market. Rather than ignore or discourage this, it decided to support it by simplifying ways to purchase spare parts and download service instructions.³⁶

We explore more of these examples in Part 2. Throughout the book, case studies and ‘snapshots’ cover a range of sectors and geographies, ranging from global ‘megabrands’ to entrepreneurs and social enterprises.

The circular economy: a generic framework

The various approaches to ‘circular’ business and economic models have slightly different emphasis on the key components. They share several common principles, aiming to:

- extend the life of materials and products, where possible over multiple ‘use cycles’;
- use a ‘waste = food’ approach to help recover materials, and ensure those biological materials returned to earth are benign, not toxic;
- retain the embedded energy, water and other process inputs in the product and the material for as long as possible;
- use systems-thinking approaches in designing solutions;
- regenerate or at least conserve nature and living systems;
- push for policies, taxes and market mechanisms that encourage *product stewardship*, for example ‘polluter pays’ regulations.

Table 1.1 Circular economy approaches – comparisons

Theme	Principle	Blue Economy	Cradle to Cradle	Circular Economy	Natural Capitalism	Performance Economy
Design	Biomimicry	Y			Y	
Design	Diversity	Y	y	Y		
Design	Systems thinking		y	Y	Y	
Conditions	Internalize externalities (policies)			Y	y	y
Conditions	Open source	y				
Conditions	Services replace products				Y	Y
Flows	Circular flows	y	Y	Y	y	y
Flows	Prioritize smallest loop			y		y
Flows	Local systems	y				Regional
Living systems	Conserve nature					y
Living systems	Regenerate nature		y		Y	
Resources	Limited toxicity				y	y
Resources	Renewable energy	y	Y			y
Resources	Resource productivity		not enough!		esp. natural	y
Resources	Waste = food	y	nutrients'	Y		~
Resources	Water stewardship		Y			
Society	Cultural ecology	y				y
Society	Social ecology	y	social fairness		meet needs	y

KEY: y = included; Y = strong emphasis; partial reference

ALSO: *Performance economy:* keep technical materials out of biosphere; jobs linked to resources or energy inputs;

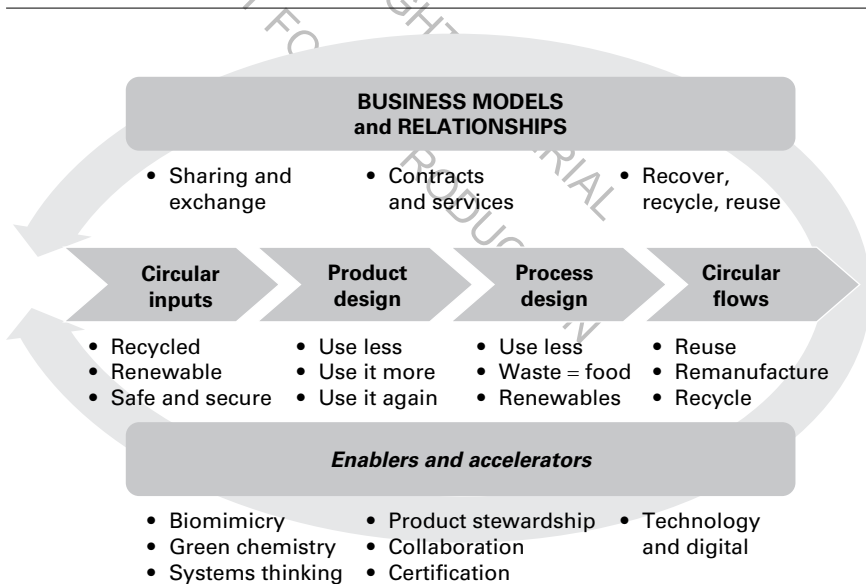
Industrial countries: 'dematerialize' allowing other countries to develop

Blue economy: gravity is primary source of energy

Table 1.1 compares the principles of the different schools of thought, and aims to provide a guide to their different emphases, rather than a definitive list of what each covers in the details behind their principles. Some approaches have emphasized ‘closing the loop’, meaning recovery of the product, parts or materials, for reuse or for making new products. In this book, we differentiate between ‘closed loop’ and ‘open loop’ circular flows, exploring the differences in Chapter 2.

This book blends the main approaches into one generic ‘circular economy framework’, shown in Figure 1.4. There are six blocks in the framework: circular inputs, product design, process design, circular flows, business models and, finally, enablers and accelerators. We look briefly at each of these here, and in detail in Chapters 2 and 3. For consistency, we use ‘circular economy’ when referring to the generic, consolidated approach, or Circular Economy to refer specifically to the approach described by the Ellen MacArthur Foundation.

Figure 1.4 Circular economy framework



Circular inputs

This means designing the product to use sustainable resources in its *bill of materials*. These should be safe, non-toxic, renewable and preferably recycled. Specifying potential substitute materials could reduce the risk of future supply shortages, improving security of supply.

Product design

Good design should aim for durability, enabling the product to last longer for its first and subsequent ‘lives’ (or use cycles) and so that it can be used again. Is it easy to disassemble and repair? Design should enable and encourage circular flows to keep the product, parts and materials circulating at the highest value, for the longest period. Design should simplify disassembly at the end of each use cycle to enable easy access to future resources.

Process design

The manufacturing process should include planning circular flows to safeguard ‘nutrients’ for future use. Processes should minimize resource use, both for materials and for process inputs including energy, water and other process aids that become *embedded resources* in the product. Can you create or develop by-products and co-products? Can you remanufacture or refurbish products for further use cycles? Could you set up mutually beneficial, or symbiotic, flows to or from other industries?

Circular flows

How will you recover the product, parts or materials without losing value in the reverse flows?

How best can you set up circular, or ‘output recovery’ flows? These include:

- reuse options, where the product is resold or shared;
- remanufacturing so that the product matches ‘as new’ performance for a second life;
- recycling to enable the materials or components to be used in another product.

Business models

Business models and commercial frameworks can support effective circulation of the product, parts or materials. These include service models to replace ownership, ‘pay per use’, lease and hire, sharing and exchange systems. Repairing, manufacturing, recycling or reselling can also form the basis of a business model.

Enablers and accelerators

We can benefit from ‘enablers’ and ‘accelerators’, along the entire value chain. Enablers include ‘green chemistry’ to improve material choice or help

develop by-products, biomimicry approaches for product design and material selection, open sourcing and systems-thinking approaches. Technology includes *cloud computing*, the *internet of things* and sensor technologies, big data, *3D printing*, *mobile apps* and sharing platforms, and *mobile internet*.

Product stewardship approaches are helping to accelerate the transition. Examples include product *life-cycle assessments*, ethical standards and certifications, and better understanding of resource footprints and sustainable material sources. Collaborative industry sector initiatives such as the Round Table on Responsible Palm Oil, or the Better Cotton Initiative, can help to accelerate the availability of more sustainable, renewable resources.

Policy and legislation is useful too, with governments introducing product stewardship or *extended producer responsibility* rules and taxes, and finding ways to make businesses pay for externalized costs such as pollution.

The circular economy approach is supported by approaches based on resource- or eco-efficiency, sustainability, *corporate social responsibility* (CSR), the *triple bottom line* and so on, but these are not as systems-focused and can probably be classed as encouraging strategies that are ‘less bad’, rather than ‘more good’.

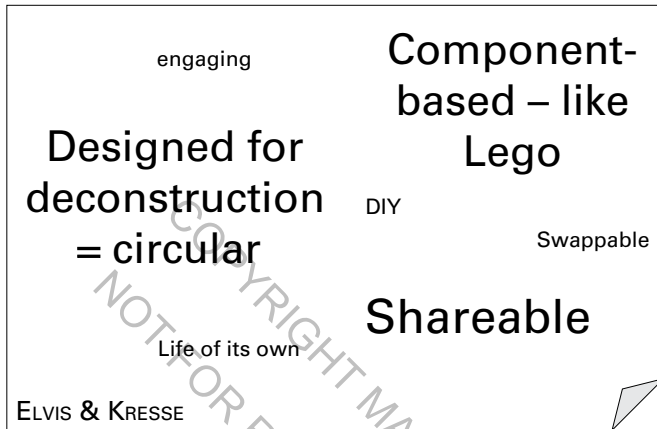
Summary

We have looked at the drivers for the circular economy concept and how it evolved, plus some examples of businesses and organizations investing in it. How should we sum up a circular economy? Each of the different schools of thought has their own definition – and there is a ‘crowdsourced’ definition too, created by Open Source Circular Economy Days:³⁷ ‘**Circular economy** is the concept of a truly sustainable economy that works without waste, saves resources and is in synergy with the biosphere. Rather than seeing emissions, by-products or damaged and unwanted goods as “waste”, in the circular economy they become raw material, nutrients for a new production cycle.’ As Professor Walter Stahel reminds us: ‘the goods of today become the resources of tomorrow at yesterday’s prices’.³⁸

The goods of today become the resources of tomorrow at yesterday’s prices.’

Kresse Wesling,³⁹ of Elvis & Kresse, gave a detailed design brief for the ‘perfect product’, shown in Figure 1.5: it should be component-based (like Lego); designed for disassembly and recirculation; can be customized, or upgraded (through ‘Do It Yourself’); and engaging, swappable, shareable and repairable – so it can have a ‘life of its own’.

Figure 1.5 The perfect product



SOURCE: Perfect product features included with permission from Kresse Wesling MBE, Elvis & Kresse

Notes

- 1 Drucker, Peter F (1992) The post-capitalist world, *Harvard Business Review*, September–October.
- 2 Stahel, WR (23 Mar 2016) [accessed 1 June 2016] The Circular Economy, Nature News, *Nature Publishing Group* [Online] www.nature.com/news/the-circular-economy-1.19594.
- 3 Carson, R (1962) *Silent Spring*, Houghton Mifflin, Boston.
- 4 WEF (2016) [accessed 1 Jun 2016] 24 Charts Every Leader Should See, *World Economic Forum* [Online] <https://www.weforum.org/agenda/2015/01/24-charts-every-leader-should-see/>.
- 5 Boulding, EK (1966) [accessed 15 August 2016] The Economics of the Coming Spaceship Earth [Online] <http://www.ub.edu/prometheus21/articulos/obsprometheus/BOULDING.pdf>.
- 6 McKinsey Global Institute [accessed 8 June 2015] Rethinking Natural Resource Management, podcast 28 November 2011 [Online] www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/a-new-era-for-commodities.

- 7 Meadows, DH, Meadows, DL, Randers, J and Behrens, WW III (1972) *Limits to Growth*, Universe Books, New York.
- 8 Product-Life Institute [accessed 9 February 2016] [Online] product-life.org/en/node.
- 9 Hawken, P, Lovins, AB and Lovins, HL ([1999] 2010) *Natural Capitalism*, Earthscan, London.
- 10 Lovins, A, Lovins, LH and Hawken P (1999) A road map for natural capitalism, *Harvard Business Review*, May–June, pp 145–58.
- 11 International Society for Industrial Ecology (2015) [accessed 7 February 2016] A Note from the Presidents (Online) is4ie.org/A-Note-from-the-Presidents.
- 12 The Blue Economy (2016) [accessed 12 February 2016] Principles (Online) www.theblueeconomy.org/Principles.html.
- 13 Pauli, G (2009) [accessed 16 February 2016] The Blue Economy: A Report to the Club of Rome, keynote speech (Online) www.worldacademy.org/files/Blue%20Economy%202009.pdf.
- 14 MBDC (2016) [accessed 12 February 2016] C2C Framework [Online] www.mbdc.com/cradle-to-cradle/c2c-framework/.
- 15 Cradle to Cradle Products Innovation Institute [accessed 18 February 2016] [Online] www.c2ccertified.org/.
- 16 Ellen MacArthur Foundation (2012) [accessed 15 August 2016] Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition [Online] <https://www.ellenmacarthurfoundation.org/news/towards-the-circular-economy>.
- 17 TU Delft with Ellen MacArthur Foundation (2016) [accessed 12 February 2016] CircularX Circular Economy: An Introduction, 1.2 Principles of the Circular Economy [Online] courses.edx.org/courses/course-v1:Delftx+CircularX+1T2016/courseware/.
- 18 Ellen MacArthur Foundation [accessed 12 February 2016] Building Blocks of a Circular Economy [Online] www.ellenmacarthurfoundation.org/circular-economy/building-blocks.
- 19 Biomimicry Institute [accessed 12 February 2016] What is Biomimicry [Online] biomimicry.org/what-is-biomimicry/#.VsW6dOahOkV.
- 20 The Natural Step (2016) [accessed 14 February 2016] About Us [Online] www.thenaturalstep.org/about-us/.
- 21 Ellen MacArthur Foundation [accessed 13 February 2016] Project Mainstream [Online] www.ellenmacarthurfoundation.org/programmes/business/project-mainstream.
- 22 European Commission (2 December 2015) [accessed 13 February 2016] Communication: Closing the Loop: An EU Action Plan for a Circular Economy [Online] eur-lex.europa.eu/legal-content/EN/TXT/?qid=1453384154337&curi=CELEX:52015DC0614.

- 23 Zhu, D, Director of the Institute of Governance for Sustainable Development at Tongji University in Shanghai, *Europe's World* (15 June 2014) [accessed 13 February 2016] China's Policies and Instruments for Developing the Circular Economy [Online] europesworld.org/2014/06/15/chinas-policies-and-instruments-for-developing-the-circular-economy/#.Vr9XGKKhOkU.
- 24 Ellen MacArthur Foundation [accessed 18 February 2016] Research and Insights [Online] www.ellenmacarthurfoundation.org/ce100/the-programme/research-and-insights.
- 25 25 PwC (2015–16) [accessed 20 February 2016] Circular Economy Solutions [Online] www.pwc.co.uk/services/sustainability-climate-change/supply-chain/circular-economy-solutions.html.
- 26 *The Guardian* (13 May 2013) [accessed 13 February 2016] Driving the Circular Economy – Infographic [Online] www.theguardian.com/sustainable-business/driving-circular-economy-infographic.
- 27 Accenture (2014) [accessed 15 August 2016] Circular Advantage: Innovative Business Models and Technologies that Create Value [Online] www.accenture.com/gb-en/insight-circular-advantage-innovative-business-models-value-growth.
- 28 McEvoy, P (5 June 2014) [accessed 13 February 2016] Groupe Renault, News, Corporate Blog [Online] group.renault.com/en/news/blog-renault/circular-economy-recycle-renault/.
- 29 Ellen MacArthur Foundation (24 July 2013) [accessed 13 February 2016] Circular Economy Applied to the Automotive Industry [Online] www.ellenmacarthurfoundation.org/circular-economy/interactive-diagram/the-circular-economy-applied-to-the-automotive-industry.
- 30 Philips (2016) [accessed 13 February 2016] Sustainability, Rethinking the Future: Our Transition Towards a Circular Economy [Online] www.philips.com/a-w/about/sustainability/sustainable-planet/circular-economy.html.
- 31 H&M [accessed 13 February 2016] Sustainability, Closing the Loop [Online] about.hm.com/en/About/sustainability/commitments/reduce-waste/closing-the-loop.html.
- 32 Farrell, S (18 January 2016) [accessed 13 February 2016] We've Hit Peak Home Furnishings, Says Ikea Boss, *The Guardian* [Online] www.theguardian.com/business/2016/jan/18/weve-hit-peak-home-furnishings-says-ikea-boss-consumerism.
- 33 Ikea Group (2016), Sustainability Report FY15, p8, 12, 14-18 www.ikea.com/ms/en_US/img/ad_content/2015_IKEA_sustainability_report.pdf [accessed 13 February 2016]
- 34 Ikea Group (2016) [accessed 13 February 2016] Sustainability Report FY15, p47 [Online] www.ikea.com/ms/en_US/img/ad_content/2015_IKEA_sustainability_report.pdf.

- 35 Ikea Group (2016) [accessed 13 February 2016] Sustainability Report FY15, p 24 [Online] www.ikea.com/ms/en_US/img/ad_content/2015_IKEA_sustainability_report.pdf.
- 36 Heidenmark Cook, P, Head of Sustainability, IKEA Retail and Expansion, Ikea Group, Rethinking Progress panel discussion, Bradford University (14 April 2015).
- 37 Open Source Circular Economy Days (2016) [accessed 18 February 2016] What is Open Source Circular Economy? In a Nutshell [Online] oscedays.org/open-source-circular-economy-mission-statement/.
- 38 Stahel, WR (23 March 2016) [accessed 15 August 2016] The Circular Economy, Nature News, *Nature Publishing Group* [Online] www.nature.com/news/the-circular-economy-1.19594.
- 39 Wesling, K (2015) Elvis & Kresse, presentation at the EPSRC & Institute for Manufacturing Industrial Sustainability conference, 6 July 2015, University of Cambridge.

Further resources

- Braungart, M and McDonough, W (2008) *Cradle to Cradle: Remaking the way we make things*, Vintage Books, London
- Ellen MacArthur Foundation (2012) [accessed 15 August 2016] Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition [Online] <https://www.ellenmacarthurfoundation.org/news/towards-the-circular-economy>
- Hawken P, Lovins AB and Lovins HL ([1999] 2010) *Natural Capitalism*, Earthscan, London

Online resources

- TU Delft with Ellen MacArthur Foundation (2016) [accessed 12 February 2016] CircularX Circular Economy: An Introduction, 1.2 Principles of the Circular Economy [Online] <https://courses.edx.org/courses/course-v1:Delftx+CircularX+1T2016/courseware/>
- Ellen MacArthur Foundation Channel on YouTube [accessed 13 February 2016] [Online] <https://www.youtube.com/user/made2bemadeagain>
- Ellen MacArthur Foundation [accessed 13 February 2016] Resources and Project Mainstream [Online] <http://www.ellenmacarthurfoundation.org/programmes/business/project-mainstream>

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