CATHERINE WEETMAN

ONLINE RESOURCES

A CIRCULAR ECONOMY HANDBOOK

2ND EDITION

HOW TO BUILD A MORE RESILIENT, COMPETITIVE AND SUSTAINABLE BUSINESS

KoganPage

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CONTENTS

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LIST OF FIGURES AND TABLES

LIST OF CASE STUDIES AND SNAPSHOTS – BY SECTOR AND COMPANY NAME

Company	Description	Sector	Chapter
General Electric	3D printing	Aerospace	9
Excess Materials Exchange	a 'dating site' for secondary materials	All	9
Renault	recycling and remanufacturing	Automotive	1
Renault	remanufacturing, reuse and 'cascading'	Automotive	9
bioMASON	microorganisms to grow construction materials	Construction	9
research	bricks from human urine	Construction	9
Calfee Design	renewable inputs	Consumer durables	2
iFixit	knowledge-sharing platform	Consumer durables	8
IKEA	'a positive impact on people and the planet'	Consumer durables	1
IKEA	simplifying reuse	Consumer durables	2
ReTuna	the world's first recycling mall	Consumer durables	3
ShareGrid platform	P2P renting	Consumer durables	3
Apple	safe, recycled, renewable materials	Consumer technology	8
Apple	trade-in	Consumer technology	8
Apple	material recovery robots	Consumer technology	8
Best Buy	keeping electronics in play	Consumer technology	8

Company	Description	Sector	Chapter
Circular Computing	the 'world's first computer remanufacturer'	Consumer technology	8
Dell	recycled and renewable inputs, closed loop process	Consumer technology	8
Electronics companies	reverse supply chains	Consumer technology	13
Environcom	circular service provider	Consumer technology	8
Fairphone	Fairtrade-certified supply chain for gold	Consumer technology	8
Fairphone 2	modular, durable and repairable	Consumer technology	8
GIAB	closing the loop on insurance claims	Consumer technology	8
Homie	pay per use household appliances	Consumer technology	8
iameco	'sustainable, ecological, high performance computers'	Consumer technology	8
Refind Technologies	artificial intelligence for reverse vending	Consumer technology	4
Repair Café	knowledge-sharing pop-ups	Consumer technology	8
Tech Takeback	pop-up events getting end-of-use consumer technology back into the loop	Consumer technology	8
Telefonica UK – O2 Recycle	rewarding recovery flows	Consumer technology	8
Adidas	recycled inputs, 3D printing	Fashion and textiles	2
Ananas Anam	Piñatex™ fabric: renewable inputs	Fashion and textiles	7
ApparelXchange	making it easy to reuse school uniforms	Fashion and textiles	7
Burberry and Elvis & Kresse	luxury products from offcuts	Fashion and textiles	2

Company	Description	Sector	Chapter
circular.fashion	closing the loop with digital identities	Fashion and textiles	7
Clothes Doctor	wardrobe maintenance	Fashion and textiles	7
Dutch aWEARness	leasing and performance contracts for clothes	Fashion and textiles	3
Elvis & Kresse	upcycled inputs	Fashion and textiles	7
Girl Meets Dress	fashion rental and subscriptions	Fashion and textiles	7
Levi Water<Less	sharing water-efficiency techniques	Fashion and textiles	2
Looptworks	upcycling	Fashion and textiles	7
Patagonia and iFixit	'do it yourself' repairs	Fashion and textiles	12
Petit Pli	inspired by origami	Fashion and textiles	7
ThredUp	clothing exchange platform	Fashion and textiles	7
Tidal Vision	green chemistry and waste = food	Fashion and textiles	7
bio-bean®	energy from waste	Food	6
Espresso Mushroom Company	mushroom growing kits	Food	6
Feedback Global	campaigning to transform the food system	Food	6
Greencup	open loop, cross-sector recycling	Food	6
GRO Holland	growing mushrooms on coffee grounds	Food	6
Milwaukee city	de-icing roads with cheese	Food	2
MyMuesli	bespoke breakfasts	Food	12
Pectcof	coffee cherry – waste = food	Food	2
The Plant	aquaponics and industrial symbiosis	Food	12
Toast Ale	recovered inputs	Food	2

Company	Description	Sector	Chapter
Tomorrow Machine	biodegradable packaging	Food packaging	2
research project	carbon fibre from algae	Industrial	4
Cisco Systems Inc	take-back and recycle programme	Industrial	2
Kalundborg	industrial symbiosis	Industrial	12
Philips	service and performance	Industrial	1
Philips	circular solutions make good business sense	Industrial	9
Rohner	Climatex Lifecycle fabric	Industrial	9
Rype Office	open loop remanufacturing	Industrial	9
Schneider	Circulars 2019 Multinational award-winner	Industrial	9
Herman Miller	design for recyclability	Office furniture	9
Warp IT	reuse platform	Office furniture	9
3D Seed	low-cost, solar-powered kit to recycle PET packaging into 3D printed objects	Packaging	4
Algramo	sharing the savings of bulk distribution	Packaging	10
ARK Reusables	reusable and recyclable food-to-go containers	Packaging	10
Frugalpac	recyclable multi-layer beverage carton	Packaging	10
Garçon Wines	flat wine bottles saving resources, volume, weight and energy	Packaging	10
How2Recycle	taking the guesswork out of recycling	Packaging	10
Loop (by TerraCycle)	making reuse easy and attractive	Packaging	10
Splosh	concentrated refills for household cleaning products	Packaging	10
TerraCycle	recycling hard-to-recycle waste	Packaging	10
Ecovative Design	growing packaging	Packaging; industrial	2
ship dismantling	reverse supply chain and recovery of materials	Transport	12

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Catherine is an international speaker, workshop facilitator, coach and host of the Circular Economy Podcast. Her consultancy, Rethink Global, helps organizations understand, use and benefit from the circular economy – exploring the 'sweet spot' where strategy, supply chain and sustainability come together.

Catherine has over 25 years' experience in manufacturing, retail and supply chains, and her career spans food, fashion and logistics, including senior roles with Tesco, Kellogg's and DHL Supply Chain.

She is a Visiting Fellow at the University of Huddersfield, a Fellow of the Chartered Institute of Logistics and Transport, and a Fellow of The RSA (Royal Society for the Encouragement of Arts, Manufactures and Commerce). She supports the global non-profit Circular Economy Club as a Mentor and Regional Coordinator for the Tees Valley, UK.

Catherine qualified as an Industrial Engineer and began her career in garment manufacturing, before moving onto logistics solution design, project management, business intelligence and supply chain consulting. Catherine gained an MSc in Logistics and Distribution from Cranfield University and her awards include the Director's Prize for Outstanding Achievement at Cranfield Centre for Logistics and Transportation, and the British Clothing Industries Association Business Fellowship Award.

Catherine says:

> I first came across the circular economy back in 2010, when I was struggling to work out how businesses could adopt sustainable strategies. After spending months researching the issues (and getting really depressed about the scale of the problem and lack of solutions), I read about the circular economy in a short book for schools: *Sense and Sustainability* by Ken Webster and Craig Johnson

of the Ellen MacArthur Foundation (2009). Suddenly the world looked much brighter, and I wanted to learn more about the circular economy and how it could solve the enormous challenges we face in creating a resilient, healthy, sustainable future. By 2013, I had decided to focus entirely on helping to 'spread the word' on why it is so important for our future, how it is taking shape and how it helps. I believe the circular economy is the best tool we have to underpin profitable, resilient and sustainable business models, and support healthy, equitable societies. My aim is to inspire you to use circular approaches in your own lives and work.

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Katie is a Senior Research Officer in Ecodesign at PDR, the International Centre for Design Research in Cardiff, Wales. Katie undertakes research, knowledge transfer activities and commercial projects which require the application of design to minimize environmental impact, increase resource efficiency and exploit circular economy opportunities. Katie holds a PhD in chemistry, which proves useful in facilitating discussions between designers, scientists and technologists, and for understanding opportunities for new materials in the circular economy. She has worked with policymakers, educators and businesses (including furniture, automotive, energy storage, electronics, sports equipment, fashion and textiles) both in Wales and internationally.

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With a background in human behaviour, real estate development and urban design, Richard has worked across

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Richard supports the Circular Economy Club, where he leads the team in York (UK) and mentors startups.

Barry Waddilove

Barry has 30 years' experience working in design and product development with brands and organizations across 25 countries. During 2014 and 2015 he completed extensive research into the role of design in the circular economy, whilst working as a Schmidt MacArthur Fellow with Cranfield University and the Ellen MacArthur Foundation. Barry holds an MDes in Design and Innovation for Sustainability from Cranfield University and is a fellow of the Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA).

Currently working as Head of Design for Electrolux, North America, Barry is exploring new innovations that meet the company's corporate objective to be circular and climate neutral by 2030.

ACKNOWLEDGEMENTS

Since I wrote the first edition of this book in 2015–16, the circular economy has progressed in leaps and bounds. For this second edition, my challenge was what to leave out, rather than how to find credible examples and evidence-based research. Again, I am grateful to the many people who have inspired me, helped and offered support. I would like to give special thanks to my contributors, including Katie Beverley, Dr Jo Conlon, Dr Regina Frei, Richard James MacCowan and Barry Waddilove; and to those who provided advice, introductions and feedback, including Jo Conlon, Lily Dunn, my colleague Peter Desmond, Alison Jones, Karen Skidmore and the Kogan Page team. Also to Calum Lewis, who provided feedback and suggestions for some of the first edition.

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Over the last five years, I've collected over 600 examples of inspiring businesses, social enterprises, startups, researchers and many others, helping to make history with circular economy innovations. I've also used the CircleLab Knowledge Hub, which has over 2,000 case studies from all around the world, and I'm now collaborating with Circle Economy to feed more of my examples into this fantastic free resource.

Thanks to my parents and sisters for their support, and to my friends, especially Lindsay Leonard and Paul Stokes for their regular encouragement and writing advice. To Ken Webster and Craig Johnson of the Ellen MacArthur Foundation for their book *Sense and Sustainability*, which provided an 'aha' moment about the circular economy in 2010, and to Gudrun Freece for her sound advice and sparking the idea for the book's focus. I'm grateful also to those who helped with the case studies for the first edition: Adam Fairweather of Re-worked, Smile Plastics and Innovations Director at Greencup coffee; Dr Carmen Hijosa of Ananas Anam, Dr Greg Lavery, Founder of Rype Office and Director at Lavery/Pennell; Cris Stephenson, Managing Director at Environcom. I'm grateful to Anna Tari and the Circular Economy Club team for providing a free-to-all resource platform and network of like-minded people.

I want to say 'thank you' to my brilliant, generous husband, Mark Jones. Yet again, he has provided boundless encouragement and done far more than his fair share of cooking, dog-walking, and cleaning, along with delivering numerous cups of tea (and pieces of chocolate) to my desk. He also 'tuned in' to the research challenge, flagging up articles and radio programmes. Without his support, this book would not exist.

Lastly, thank you for learning about the circular economy and helping develop smarter ways for business to support society and our living planet. I hope you find inspiration and stories in these pages to help you create better businesses – and a better world.

Introduction

You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.

R BUCKMINSTER FULLER[1]

In the face of the climate and ecological emergency, the choices we make matter more than ever. Everything we do – how we work, live, travel and socialize – can either regenerate our planet and the living systems we depend on, or destroy it. In just a few centuries we've increased our negative impact on the earth, its atmosphere, the climate, air, water, soil and nature, to unsustainable levels. We've moved from a world of abundance and limitless potential to a world of scarcity, constraints and fear.

The circular economy is an essential tool in our survival kit, giving us smarter ways to design, make and use everything. Instead of using systems of extraction, pollution and waste that ultimately lead to lost value, we can design systems to reuse, repair and regenerate, creating value opportunities for business and society.

A growing body of information focuses on the concept and principles of the circular economy, highlighting macro-level implications for sectors and regions. In contrast, this book builds on the underlying principles and theory to examine how it works in the real world. Practical strategies and real examples for businesses of all shapes and sizes, in every industrial sector, including lots of startups and small businesses, prove that circular approaches are profitable, resilient and sustainable.

I've focused on what it means for businesses, their customers and supply chains, using plain language and avoiding jargon, aiming to make it easy to absorb. I hope to inspire you to use circular approaches in your own lives and work.

I've included and built on the core concept and elements from leading thinkers and researchers, including the major schools of thought (including Walter Stahel, McDonough and Braungart, Gunter Pauli, the Ellen MacArthur Foundation and Industrial Ecology), business groups, consultancies and eminent scholars.

My career background in manufacturing, retail and the supply chain across food, fashion and FMCG has helped me understand the 'sweet spot' where strategy, supply chain and sustainability come together, to see a wealth of opportunities to design products, services and business models that help us to use our resources, instead of using them up – once they're gone, they're gone. We need to regenerate resources, living systems and societies, instead of creating waste, pollution and destruction.

The book answers questions that come up in conversation with the people that I coach, and at talks and workshops, including:

- What is the circular economy, how did it emerge, and how have the various approaches converged?
- How is it different from 'traditional' business: for product designs, materials, production, supply chains, and for business models?
- Why does it matter – what are the global drivers and trends causing businesses to invest in it and governments to encourage it? How is it better for business and society?
- How is it starting to take shape, in a range of market sectors and businesses of all shapes and sizes?
- How does it change traditional approaches to supply chain strategy and operations?
- How do you create a business case to convince investors and stakeholders, and to make a compelling case for change?
- How should businesses get started on a road map to circularity? Where should they focus first, and how might they measure progress and success?

We will answer these questions, and more, as we investigate what the circular economy means for a range of industry sectors, and along the supply chain. Lots of new business jargon is emerging to describe these 'disruptive innovations' (see Figure 0.1), and we unpack these.

FIGURE 0.1 Buzzwords for a new industrial revolution

SOURCE: © Catherine Weetman

The second edition

Since writing the first edition in 2015–16, my work in consulting, coaching and speaking meant I continued to collect insightful research and new case studies. When reading through all the notes, examples, journal articles and white papers I'd collected, I realized just how much had changed – this was going to be nearly as big a project as the first edition! Included in the many updates are a new chapter on packaging, major updates to Chapter 3 on business models and a new version of my Circular Economy Framework. The chapter on enablers includes new contributions on biomimicry and ecodesign, plus extra insights on technology such as artificial intelligence and blockchain. Throughout the book, I've added lots of new examples of companies and other organizations putting circular economy principles into practice – 'making it real'.

Global trends signalling a new direction

The next industrial revolution is already under way, with digital technologies transforming products and market sectors. However, there are major challenges, and business leaders have deep concerns about the volatile costs and reliability of access for many resources. Demand is outstripping supply,

and we are failing to meet the basic needs of billions of people, with worsening problems of poverty, hunger, access to drinking water and sanitation. Human impact has transformed our planet to such an extent that scientists argue we have entered a new geological epoch – the Anthropocene.[2]

We are the best-informed generation in society – ever. Scientists are discovering more, every day, about how we can conserve, restore and regenerate our world, and how our current materials, methods and models are destroying and depleting it.

Over the last 150 years, as mass manufacturing developed, we have adopted a linear system. We take some materials, make a product and then discard it at the end of its use. This system of 'take, make, waste' (the linear economy) has moved us into 'ecological overshoot'. Each year, the world population is consuming at the level of 1.75 planets.[3] In the past 50 years, we have destroyed or degraded 60 per cent of the earth's ecosystems – our life-support systems.[4] Around the world, we can see the effects of climate change, with flooding, droughts, storms, wildfires, ocean acidification, species extinction and much more. In October 2019, scientists from the Intergovernmental Panel on Climate Change (IPCC) delivered a stark warning: to avoid the catastrophic impacts of climate change, global warming cannot exceed 1.5°C above pre-industrial temperatures. That means we must halve *greenhouse gas (GHG)* emissions by 2030 and reduce them to net-zero by the middle of the century. The circular economy plays a major role in reducing GHG emissions and supporting progress towards the United Nations Sustainable Development Goals (SDGs).

People expect companies to be doing the right things – sourcing ethical, safe materials, making durable, repairable products and providing end-of-life solutions for what they sell. According to Euromonitor International's latest sustainability survey, 54 per cent of global consumers believe ethical purchase decisions will make a difference and one-fifth of the global consumer population prefer to repair damaged items.[5]

How is the circular economy better?

Instead of the 'take, make and waste' approach, the circular economy focuses on circulating resources instead of using them up, and designs waste out of the system. We aim to get more from less, getting more 'use' and value from every product, component and material, and ensuring all 'waste' becomes food – for another industrial process, or for nature – so regenerating future resources and the living systems we depend on. By doing this, we can

Success means reframing the way we think about design and rethinking the business model. The focus is on how to find value opportunities – creating, conserving and circulating value – and discovering ways to add value for stakeholders, including customers, suppliers and wider society.

In a circular economy, where waste = food, businesses that focus on keeping their customers for life and developing products that have a 'life of their own' will thrive. Ray Anderson, the founder of Interface, summed it up superbly:[7]

> taking nothing, wasting nothing and doing no harm – and doing very well by doing good, at the expense not of the earth but of less alert competitors.

The book structure

Part One: An overview of the circular economy

We begin with an overview of the circular economy, how it evolved, the main concepts and leading contributors. My circular economy framework 2.0 builds on the common themes from the key schools of thought, and in Chapters 2 to 4, we look at what it means in practical terms for business and in value chains. Chapter 2 looks at the framework's central flow, the 'design and supply chain'; Chapter 3 explores the various business models and their implications; Chapter 4 reviews 'enablers and accelerators', helping create opportunities and incentives for circular approaches.

Part Two: How are businesses adopting circular economy models?

In this Part, we start with the global drivers and trends, including those risks and issues keeping business leaders awake at night. In the next five chapters, we unpack what this means for a range of industry sectors, looking at issues and risks for the 'traditional' supply chain for that sector, followed by practical examples for each element in my circular economy framework.

Part Three: What does this mean for supply chains?

Circular supply chains will evolve to manage an 'ecosystem' with complex choices; aiming for resilience and agility. Chapter 11 focuses on strategy and planning, including network design to suit distributed manufacturing and

locally recovered materials. I share my 'eight sustainability principles' for supply chains and show how these can guide decisions and priorities for supply chain redesign. We look at how the supply chain team can develop their own circular initiatives and examine the role of product life-cycle management.

Chapter 12 explores how supply chain operations – including sourcing and procurement, manufacturing, distribution and reverse logistics – need to evolve for a circular economy. We cover remanufacturing, life cycle assessments, technology and other enablers, plus relationships, partnerships and collaboration, and highlight value opportunities in the supply chain itself.

Part Four: Implementation

In Chapter 13, we suggest ways to implement circular economy approaches: whether for an entire business; for a product; or perhaps starting with some aspects of how we design products or processes. How can we create a compelling business case for change and set the strategic direction, involving a wider group of stakeholders to uncover value opportunities? What risks, opportunities and other factors should we consider? What are the common barriers and objections, and how can we overcome these? This chapter includes toolkits and resources to identify opportunities and measure progress and success.

Although I aim to avoid jargon, I recognize that new terms and phrases are emerging and become 'shorthand' – saving time once you are familiar with them. To provide a quick reference for these new words you will see in reports and publications, I include a glossary of terms. In the chapters, **glossary terms** are highlighted in *italics*, generally the first time they appear in each main section within a chapter (unless they are explained within that chapter). A list of all the case examples, organized by industry sector, is included at the early pages of the book.

Numbering: the book uses the following numbering system:

One million = 1,000,000
One billion = 1,000,000,000 = 1,000 million
One trillion = 1,000,000,000,000 = 1,000,000 million (1 million million)

Notes

1 Buckminster Fuller Institute www.bfi.org/ideaindex/projects/2015/greenwave (archived at https://perma.cc/QS4B-LP4G) [accessed 27 December 2019]
2 Lewis SL and Maslin MA (2015) Defining the Anthropocene, *Nature*, **519**, pp 171–80 (11 March 2015)
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PART ONE

An overview of the circular economy

Businesses large and small, around the world – established global corporates, and disruptive startups – are rethinking business models and product design. They aim 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 Two and explore the global trends and drivers creating the context for circular approaches in Chapter 5. First, in this chapter, we explore the circular economy in more depth, looking at:

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

Instead of leaking value by discarding products and materials after use, the circular economy redesigns products, processes, supply chains and business models to **create, conserve and circulate value**. Creating durable products, and recovering products and materials at end-of-use, enables reuse, repair, remanufacture and recycling. Simple examples include:

- Making orange juice: the 'waste' becomes by-products, with pectin, pulp and zest for food manufacture and essential oils for pharmaceuticals and cosmetics.
- Commercial photocopiers aren't sold now; photocopying is a service with efficient repair networks, together with refurbishing and remanufacturing to enable second and third 'lives' for each machine.

Circular economy approaches regenerate resources and ecosystems, supporting our health and well-being. By converting 'take-make-waste' into 'value loops', thus creating more from less, they decouple resource use from value creation.

Circular economy terminology often categorizes materials into two groups.

- Biological (renewable) nutrients – food, fibres, timber – should be sustainable and renewed to meet or exceed the rate of extraction.

- Technical (finite) nutrients – metals, minerals, fossil fuels – should cycle infinitely. Product design can support effective separation at the end-of-use, for efficient recycling.

This over-simplifies the choices but starts to encourage a different mindset, focusing on material choices and the ease of separation at end-of-use.

Why is the circular economy important?

Why do we need a different approach to business? 'Traditional' industrial processes are a 'linear economy', meaning we take materials, make something, use it and then dispose of it. We could even call it a 'waste economy'!

TAKE, MAKE, WASTE

Modern lifestyles rely on finite resources – metals, minerals and fossil fuels. Our economy also relies on land and water – and we often forget that they are finite too. We dump waste and pollution at every stage of the process, destroying the living systems we depend on, and sometimes harming people. When we discard the product, we waste all those resources – and we waste all the energy, labour and knowledge we invested in the product at every stage in the process.

The linear economy relies on companies striving to sell more: we try to cut costs, try to encourage customers to buy the latest version, or persuade them to buy products with a short life-cycle (eg fashionable clothes). We try to create new 'needs', like antibacterial wipes for your kitchen, bottled water, probiotic yoghurt, or smart speakers.

We extract around 90 billion tons of natural resources, every year, to make what we consume. That's more than 12 tons for every person on the planet. Based on current trends, that number is likely to double by 2050.[3] The systems we've created are shockingly wasteful. The Circularity Gap report says we recover less than 10 per cent of our resources to make them into new products.[4]

We now know we are causing dangerous climate change by burning fossil fuels, using fertilizers and clearing forests, all of which creates greenhouse gas (GHG) emissions. Our world population continues to grow, and people have more money to spend on food, clothing and other stuff. It's great news that people's standards of living are improving, but the downside is that we are creating ever more demand for resources.

FROM DESTRUCTION TO REGENERATION

This system is threatening our future on this planet, with lots of downsides:

- people feel excluded, fearful and exploited;
- businesses face resource scarcity, higher charges on waste and risk to their reputations; and
- we are overloading and depleting nature's living systems.

It's easy to forget that we depend on living systems that provide critical services for us, including pure air, clean water and healthy soils. We are realizing that the way we live and work is destroying nature and pushing the earth's systems towards irreversible tipping points, threatening our ability to survive and thrive.

Governments, businesses large and small, NGOs and consultancies are recognizing these critical problems and risks. They see the potential to redesign the systems that depend on unsustainable consumption and are investing in circular economy approaches. The World Economic Forum, McKinsey, the Ellen MacArthur Foundation, the European Union and many other organizations are helping to accelerate the transition to a circular, resilient and sustainable world.

> Businesses that work on the basis of circular principles are amongst the fastest growing in the economy.
>
> Dr Martin R Stuchtey, McKinsey Center for Business and Environment[5]

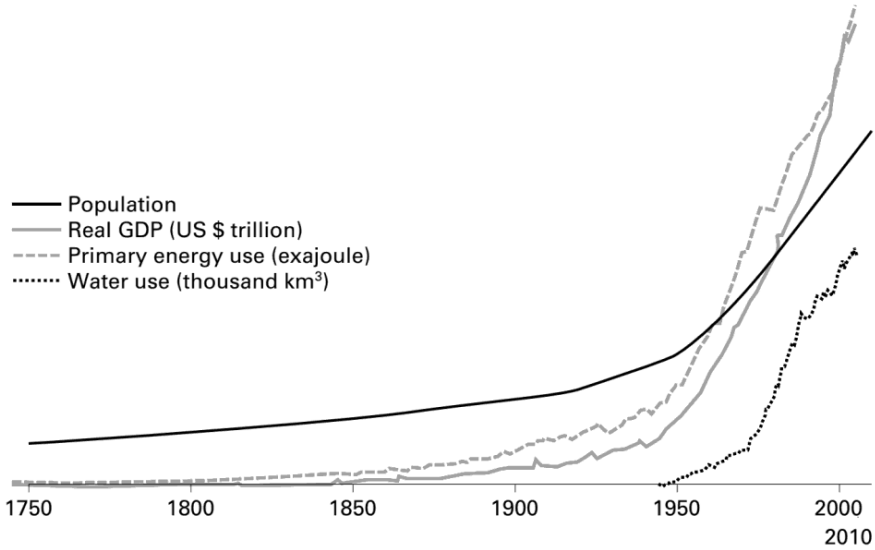
Background

As the industrial revolutions scaled up, changing the way many people lived, worked, travelled and communicated, it seemed that resources were unconstrained. Effectively, we were a relatively small population on a large, bountiful planet.

Since the 1950s, agricultural practices have changed in many developed nations, using synthetic fertilizers, chemical pest controls 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. Rachel Carson, in her book *Silent Spring* (1962), raised public awareness of the environment and destruction of wildlife through the widespread use of pesticides.[6] The press condemned her, and the chemical industry even tried to ban the book.

From the 1970s onwards, we began to recognize that many of the resources we rely on for our survival are either finite; or are constrained by

FIGURE 1.1 The great acceleration



SOURCE: Stockholm Resilience Centre[7]

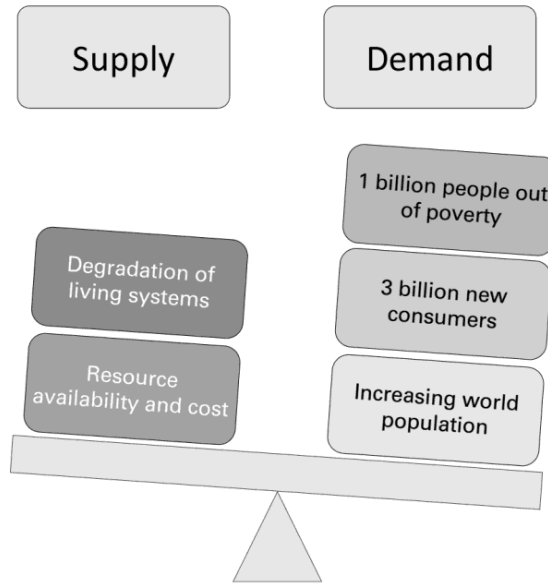
the speed of regeneration or availability of land in our urban environments. In *Small is Beautiful* (1973), EF Schumacher writes about the need to adopt Buddhist economic principles, understanding 'the essential difference between non-renewable fuels like coal and oil […], and renewable fuels like wood and water power'.[8] He goes on to explain that 'non-renewable goods should be used only if they are indispensable, and then only with the greatest care and the most meticulous concern for conservation.'

Economist and systems theorist Kenneth Boulding described the issues of open and closed systems in relation to economics and resources.[9] Would growth be limited first by running out of places to store our waste and pollution, or by humanity running out of raw materials to use? Boulding advocated focusing on maintaining our resource stocks and encouraging technological change to reduce production and 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. As the effects of this 'great acceleration' became clear, scientists and institutions began to question our 'traditional' ways of making, selling and consuming products. You can see more on the World Economic Forum website.[10]

As we improved techniques for mining, extraction and manufacturing, resource costs declined steadily, despite some short-term increases resulting

FIGURE 1.2 Tipping point



SOURCE: © Catherine Weetman

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, described by consultants McKinsey as a 'century of price declines, reversed in a decade'.[11] We have found, and used, all the 'easy to get at' stuff. Worse still, prices are now volatile, 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 pressure on the cost of supply. We have serious global challenges of 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. Increasing pressures of demand, coupled with challenges for supply of resources, and the health of the living systems we depend on for clean air, safe water, food, timber, pollination and medicine, mean we need to rethink our systems. We explore this further in Part Two.

Reports from the United Nations, the European Commission, the OECD, the World Economic Forum and global management consultancies echo the

Natural capital includes 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. If we tried to substitute pollination services, provided by bees and butterflies, with hand or robot pollination, we quickly see 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:[15]

- Increase the **productivity of natural resources**. Innovations can stretch natural resources by 10, or even 100, times further than today. Crucially, the financial savings can help companies to implement the other three principles.
- Use '**biologically inspired**' production models and materials. In closed-loop systems, modelled on nature, every output is either returned to nature as a nutrient (waste = food) or becomes another manufacturing input.
- '**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 objectives and rewards, through resource productivity and product longevity.
- **Reinvest in natural capital** to ensure future prosperity. Using up finite resources means those resources are no longer available. For example, polluting water sources destroys clean water supplies as well as the healthy habitats for fish and other species.

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

Industrial ecology

Preserving the materials and energy 'embedded' in a product – raw materials, energy, water and other process aids – is a basic tenet of industrial ecology.[16] It aims to help businesses understand 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.

A key indicator of a country's environmental impact is what it consumes, rather than what it produces. 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 and emissions from one process become the raw materials for another.

Blue Economy

Economist Gunter Pauli's first *Blue Economy* book in 2010 bases its solutions on physics, using nature's systems of cascading nutrients, matter and energy as the ideal model.[17] 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.

The Blue Economy is 'where the best for health and the environment is cheapest and the necessities for life are free thanks to a local system of production and consumption that works with what you have'.[18] Waste does not exist, and any by-product can be the source for a new product. Pauli urges us to question the use of all materials used in production – can you manage without it? Can you do more with less? He 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'.

Pauli believes that our current economic model relies on scarcity as a basis for production and consumption. In contrast, Pauli defines 'wealth' as diversity, the opposite of our industrial standardization. Sustainable business maximizes the use of available material and energy, so reducing the unit price for the consumer. Sustainable business respects local resources, culture and tradition.

Between 2010 and 2013, Pauli published over 100 innovative case examples, aiming to create 100 million jobs and substantial capital value by 2020. All innovations are open-source and published on the Blue Economy website (www.theblueeconomy.org (archived at https://perma.cc/VNM9-6QZU)).

Cradle to Cradle®

Architect William McDonough and Dr Michael Braungart, an environmental scientist, wrote *Cradle to Cradle: Remaking the way we make things* in 2002. They describe 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'. They reject the idea that growth is bad for the environment, reminding us that, in nature, growth is good.

Instead of 'eco-efficiency', they aim for 'eco-effectiveness', driving innovation and leadership towards positive goals. They argue that eco-efficient, demand-side approaches may only reduce or minimize damage: eco-efficiency is simply sensible business practice. Eco-effectiveness 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:[19]

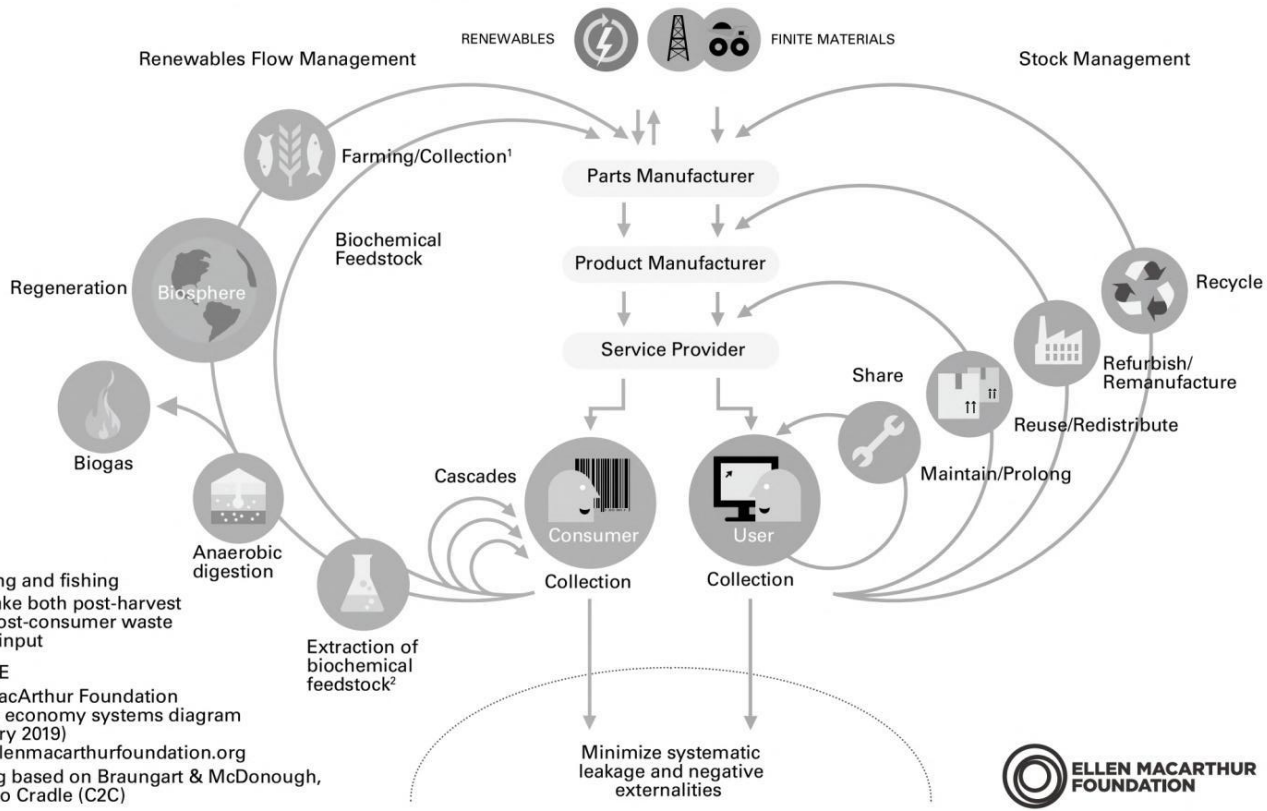
- **material health:** value materials as nutrients for safe, continuous cycling;
- **material reutilization:** maintain continuous flows of *biological* and *technical nutrients*;
- **renewable energy:** power all operations with 100 per cent renewable energy;
- **water stewardship:** regard water as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

McDonough and Braungart have developed the 'Cradle to Cradle Certified™ Product Standard', managed by the Cradle to Cradle Products Innovation Institute, an open-sourcing, non-profit organization.[20] The standard 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.

Ellen MacArthur Foundation

One of the highest-profile organizations promoting the circular economy is the Ellen MacArthur Foundation (EMF), a charity set up by the record-breaking round-the-world sailor, Ellen MacArthur. It works with businesses,

FIGURE 1.4 Ellen MacArthur Foundation systems (butterfly) diagram



(Reproduced with kind permission of the Ellen MacArthur Foundation)

governments and education to accelerate the transition to a circular economy, and publishes a wide range of books, papers and videos explaining the concept, principles and benefits. The foundation works closely with consultants McKinsey and with a wide range of global businesses, which form its 'CE100' group.

The first major report in EMF's 'Towards the Circular Economy' series, in 2012, broke new ground, calculating the economic and business opportunities for a restorative, circular model.[21] EMF's 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'.[22]

EMF has three principles for a circular economy:[23]

- **Design out waste and pollution** – what if they were never created in the first place? This includes designing out the negative impacts of economic activity damaging human health and natural systems.
- **Keep products and materials in use** – what if we could build an economy that uses things rather than uses them up? Preserving value means designing for durability, reuse, remanufacturing and recycling, to keep products, components and materials circulating in the economy.
- **Regenerate natural systems** – what if we could not only protect but actively improve the environment? A circular economy avoids the use of non-renewable resources and preserves or enhances renewable ones, for instance by returning valuable nutrients to the soil to support regeneration, or using renewable energy as opposed to relying on fossil fuels.

Figure 1.4 shows EMF's Circular Economy Systems Diagram (the 'butterfly diagram'), with the flows and priorities for circulating renewables (biological materials) and loops for finite (technical) materials.[24]

Building on several schools of thought and influenced by Cradle to Cradle's material cycles, the 'butterfly diagram' is often used to explain the circular economy, with the tightest 'loops' retaining the most value.

If we think about food, we consume it … it can't be 'reused' in its original state. In the 'butterfly diagram', the loops for food and other biological materials include biochemical extraction, biogas, and agricultural regeneration.

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

the concept of 'mottainai', meaning it is a shame for something to go to waste without using its full potential. Japan has wide-ranging recycling laws, covering everything from plastic and paper to home appliances and construction materials.[31]

Global consultants, business groups and NGOs

Major global management consultancy McKinsey & Company is a high-profile circular economy advocate. It has published several papers, is knowledge partner to the Ellen MacArthur Foundation (EMF) and provides research and insight for many of the EMF and World Economic Forum (WEF) reports.[32] Another consultancy, PwC, includes 'circular economy solutions' as part of its Sustainability Services, was involved in the RSA Great Recovery project[33] and has published white papers and blogs. Accenture 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.[34,35]

New consultancies have emerged to help governments, cities, sectors and individual organizations to understand the opportunities and implement circular economy strategies. In particular, social enterprise Circle Economy and Metabolic (founded in 2012) have contributed to the growing range of white papers and thought leadership articles. In addition, Circle Economy hosts the Circle Lab open-sourced database of circular economy case studies, with over 1,000 worldwide examples by 2019 (see Further Resources at the end of this chapter).

UNITED NATIONS

The United Nations Industrial Development Organization (UNIDO) sees the circular economy as a 'new way of creating value, and ultimately prosperity, through extending product lifespan and relocating waste from the end of the supply chain to the beginning – in effect, using resources more efficiently by using them more than once'.[36] Seeing the circular economy as complementary to the United Nations Sustainable Development Goals, UNIDO projects include resource-efficiency, safe and easily recyclable products with longer lifetimes, and recovery of end-of-use products and materials.

WORLD ECONOMIC FORUM (WEF)

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'. Building on this work, WEF launched its Platform for Accelerating the Circular Economy (PACE) in 2017, as a public–private collaboration.[37] In 2019, the PACE co-chairs were the CEO of Philips, the heads of the Global Environment Facility and UN Environment, supported by the Ellen MacArthur Foundation, the International Resource Panel, Circle Economy and Accenture Strategy.

PACE aims to create systems change at speed and scale by enabling partners to:

- develop blended financing models for circular economy projects, in particular in developing and emerging economies;
- help create and adjust enabling policy frameworks to address specific barriers to advancing the circular economy;
- bring the private and public sector into public–private collaborations to scale impact around circular economy initiatives.

WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT

The World Business Council for Sustainable Development (WBCSD) says, 'The future of business is circular, and there's no room for waste in it.'[38] It also sees the circular economy as critical to supporting the United Nations Sustainable Development Goals. Its circular economy programme, Factor 10 (referring to a need for a ten-fold improvement in 'eco-efficiency of materials'), aims to 'bring circularity into the heart of business leadership and practice'.

Global businesses getting on board

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

RENAULT: RECYCLING AND REMANUFACTURING

In 2000, Renault began integrating the circular economy into its activities, aiming to 'turn our waste into resources'. Renault tells us that today, over 85 per cent of automotive vehicles are metals and plastics, highlighting the importance of reusing these materials instead of discarding them.

Renault's corporate 'blog', 'Circular economy: re-cycle, re-use, Re-nault!', describes the circular economy as 'the ultimate recycling programme, where

ideally nothing goes to waste'.[39] By 2014, the Renault Espace car was 90 per cent recyclable, and all cars in the 2014 range included 30 per cent recycled materials.

By 1999, Renault's circular economy plans included developing mobility services, such as car-pooling, car-sharing and short-term rental, through Renault Mobility. Groupe Renault signed the French Government's Circular Economy Roadmap, which 'focuses on moving towards a 100 per cent plastic recycling rate in France by 2025'.[40]

PHILIPS: SERVICE AND PERFORMANCE[41]

Philips' 2016–2020 strategy sets out 'ambitious targets for the company's solutions, operations and supply chain'. By applying ecodesign and circular economy principles to design solutions, Philips develops new business models and ways of working with customers to 'deliver better health at lower cost and use resources in the most effective way'.

In addition to 'improving the lives of 2.5 billion people each year', its 2020 objectives include 70 per cent of turnover from solutions that meet ecodesign principles, and 15 per cent from circular economy principles:

- carbon-neutral operations;
- recycle 90 per cent of operational waste and send zero waste to landfill;
- sustainable, collaborative approaches with suppliers.

IKEA: 'A POSITIVE IMPACT ON PEOPLE AND THE PLANET'

Speaking at a *Guardian* conference, Steve Howard, IKEA's former Chief Sustainability Officer, 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.[42]

In the 2018 update to its 2012 People & Planet Positive sustainability strategy,[43] IKEA recognizes its reliance on both natural resources and people. By transforming how it works, from linear to circular, it can 'secure the future of the IKEA business, value chain and the livelihoods of the millions of people

that contribute to it'. It sees the three key challenges as climate change, unsustainable consumption and inequality.

By 2030, its ambition is to 'be a circular business built on clean, renewable energy and regenerative resources, de-coupling material use from our growth'. This includes:

- ending its dependency on virgin fossil materials and fuels;
- contributing to a world of clean air, water and improved biodiversity;
- turning waste into resources, sending zero waste to landfill;
- transforming secondary materials into clean and safe resources;
- sourcing and producing renewable and recycled materials with a positive environmental impact;
- set up and promote systems and services to enable a circular economy;
- becoming 'forest positive', promoting sustainable management to eliminate forest degradation and deforestation;
- becoming 'water positive', by leading and developing water stewardship programmes;
- leading regeneration projects on degraded land.[44]

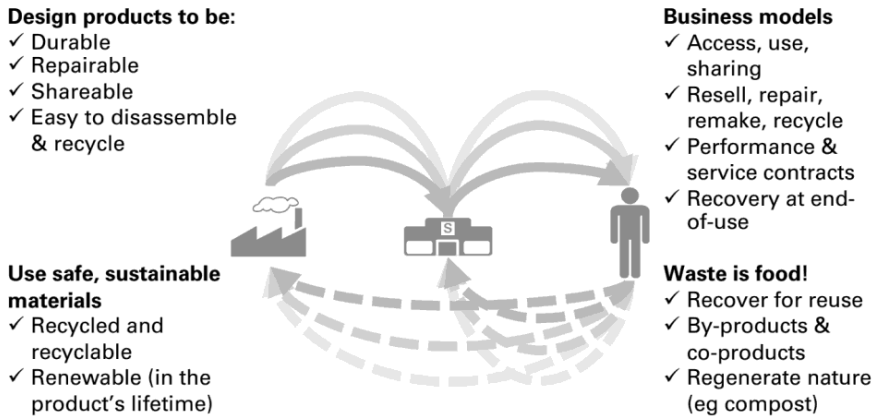
Businesses adopting circular economy approaches are reducing risk, increasing reliance and improving their competitive edge. They're focused on 'doing more good', not just a 'bit less bad', engaging customers, employees and other stakeholders and helping their business be fit for the future.

Throughout the book, we highlight case studies and 'snapshots' covering a range of sectors and geographies, from global 'megabrands' to small businesses, entrepreneurs and social enterprises.

The circular economy: a generic framework

Those early concepts evolved into many 'circular economy' approaches, promoted by governments, NGOs and consultancies. A study by Kircherr, Reike and Hekkert in 2017 found 114 different definitions of a circular economy![45] Generally, they share common principles, as summarized in Figure 1.5.

FIGURE 1.5 Circular economy principles



SOURCE: © Catherine Weetman

- **Design products and equipment** to be **durable, repairable** and robust, so they stay in use for longer. For the user, the benefit is a better lifetime cost, because robust, repairable products can be rented or shared, therefore more people can use fewer products. Products and resources are more productive: for example, a rented city bike might be in use for 12 hours a day, whereas a 'personal' bike might be used just a couple of times each week. Designs should enable efficient and effective disassembly too, for remanufacturing and recycling.
- **Business models** encourage access and use of products and equipment, instead of ownership. Contracts for service and performance help 'win-win' outcomes for the supplier and customer; and commercial options should encourage recovery of the product, components and materials at the end-of-use. Circular approaches also create markets for new services: for sharing, reselling, reuse, repair, remanufacturing and resource recovery.
- We should use **safe, sustainable materials** that are recycled (and recyclable) or renewable, both for the product and its manufacture.
- **Recover the products, components and materials** at the end of each phase of use, for reselling, repair, remaking or recycling. The aim is to retain the usefulness and value of products and resources, so we can use them as a resource for another industrial process, or they can become food for nature – compost!

Table 1.1 compares the principles of the different schools of thought and aims to outline their different emphases, rather than provide a definitive list