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Foreword

The construction industry accounts for approximately 60% of UK materials use and one third of all waste arisings. Buildings are stripped out every few years and often torn down well short of their design life with hardly any products or materials being reclaimed for reuse. This linear model of 'take, make and dispose' is depleting the world's precious resources and is creating mountains of waste with very little scope for reclamation.

In a circular economy, resources are kept in use and their value is retained. This starts at the design stage, where products are designed for disassembly and reuse and new business models incentivise reclaiming, refurbishing or remanufacturing products. In the building industry's current, linear model, topics such as materials selection, waste reduction, resource efficiency, adaptability and design for deconstruction are at best treated as separate issues. At worst they fall short of being considered due to the fragmentation of responsibility within the construction industry, as each discipline blames the next for a lack of holistic thinking or long-term vision.

Applying circular economy thinking to buildings provides an opportunity to draw together all of these seemingly disparate performance aspects into a cohesive whole that creates multiple benefits for people and the environment.

In this book, David Cheshire has created a simple framework and a set of circular economy principles specifically for the built environment. He goes on to explain each of these principles and uses case study examples to show how construction clients, designers and occupants can create a more regenerative built environment.

The case studies show that applying circular economy principles to buildings ensures that they use less resources, can be adapted to different uses and even provide healthier environments for people to live and work in. At the same time, the total cost of ownership can be reduced by engaging with the supply chain and by applying leasing models to shift the cost of upgrade and disposal of equipment back to the manufacturer.

Instead of designing buildings like there is no tomorrow, we need to think about the future of buildings and their users. The profligate attitude we have so far applied to construction resources will not be compatible with the priorities of future generations. It is high time we addressed this, and recognised our stewardship role over the planet's finite resources. Such a transformation of the built environment industry is at the heart of the UK Green Building Council's mission, so I welcome the work David Cheshire has put into articulating a different future for an industry with so much potential for greater efficiencies.

Julie Hirigoyen, CEO, UK Green Building Council

industrial symbiosis in action, such as ceramic waste from the pottery industry becoming aggregate for a construction company, resulting in cost savings for both industries and reduced carbon dioxide emissions and waste.

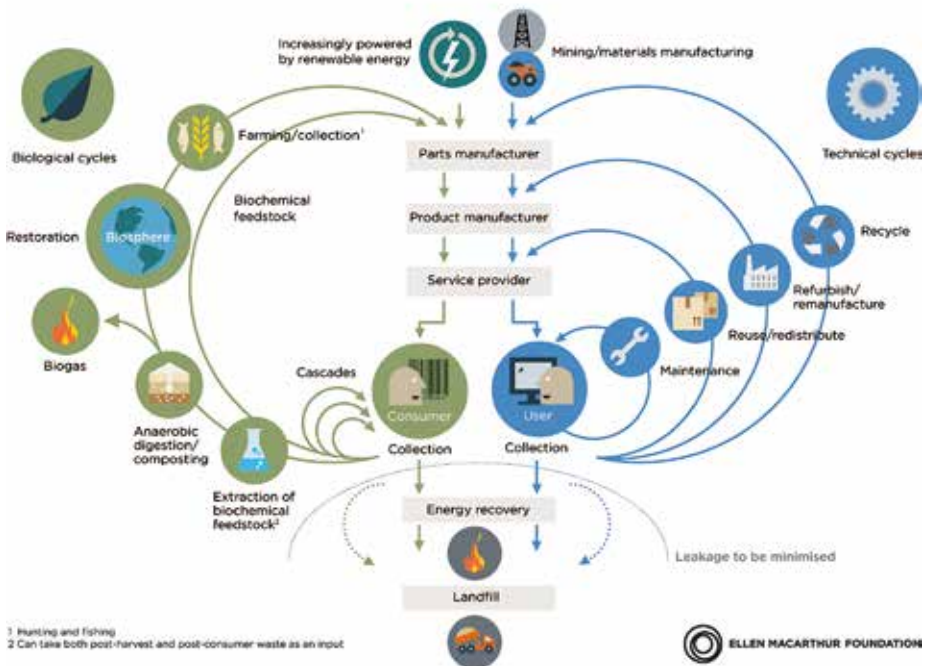
Principles of a Circular Economy

A recent interpretation of a circular economy has been made by the Ellen MacArthur Foundation in a series of reports that include an evolved set of principles and compelling arguments for making the transition.¹⁴ The reports include a diagram that captures and summarises the principles, as shown in Figure 1.02. The principles behind this diagram and how they apply to buildings are explained in this chapter and throughout this book.

From the very start, the aim should be to design-out waste and to think about products and materials as a precious resource that has to be preserved, rather than being wasted after it has been 'consumed'.

Figure 1.02: The circular economy.

CIRCULAR ECONOMY - an industrial system that is restorative by design.



02. Why create a circular economy?

We have an uncertain future because our economy runs from a manufacturing perspective. We take a finite number of resources, we make something out of them and ultimately, at the end of their life, we throw them away.

Dame Ellen MacArthur

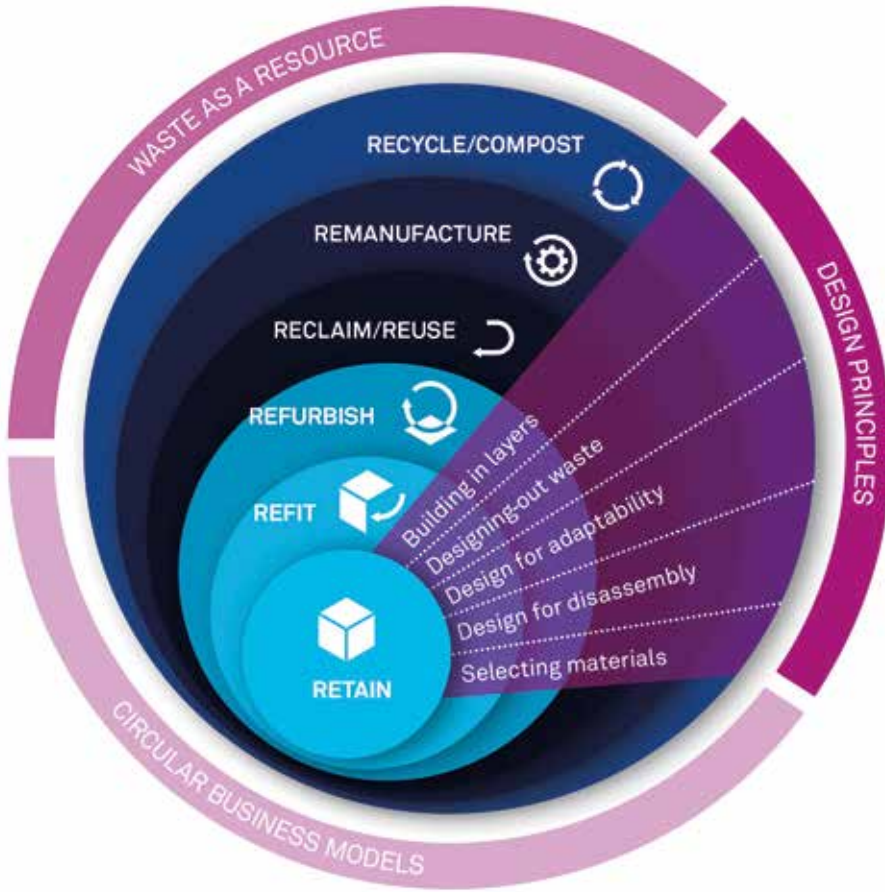
Population growth and the escalating demand for consumer products are driving up the demand for resources. It is predicted that, by 2030, three billion people who are currently living in poverty will join the middle-class level of consumption, which would create a corresponding surge in the demand for resources. According to the Ellen MacArthur Foundation, even the more conservative projections suggest that demand for natural resources will increase by at least a third.¹

This increasing demand is creating price volatility and disruptions in the supply of essential raw materials, caused by conflicts, disasters or by countries restricting the international trade in raw materials, such as when China restricted the export of rare earth elements. This restriction created a sharp hike in prices of products that relied on these elements (e.g. in 2011, a price increase of over 300% was reported for rare earth phosphors used in fluorescent lamps).²

Environmental issues are the underlying reasons for many of the supply disruptions and climate change is causing more extreme weather events, adding to the problems. The Thailand floods reportedly led to a shortage of components for UK car manufacturers.³

Winning and processing resources is putting increasing pressure on the environment as these essential raw materials get harder to extract. Mining and drilling in more remote

Figure 5.01: Applying circular economy principles to building design.



Concentric Circles

The nested circles show the hierarchy with the three inner circles being the most desirable. Retaining the existing building is the most resource-efficient option, followed by refits and refurbishment of existing buildings, as this retains the most resource-intensive parts of the building. For the three outer circles, the priority is to reclaim or remanufacture components, with the last option being to disassemble them to recycle back into new products or return the materials to the biosphere. This hierarchy underpins the design principles covered in this book.

07. Designing-out waste

Waste does not exist when the biological and technical components (or 'nutrients') of a product are designed by intention to fit within a biological or technical materials cycle, designed for disassembly and refurbishment.

Ellen MacArthur Foundation, 2013

A circular economy is not just about designing-out waste, it is fundamentally designing-out the concept of waste. This means that designers have to think about the whole life of the building from the decision to build new or refurbish through to the eventual demolition or deconstruction of an obsolete building.

Therefore, the idea of designing-out waste means avoiding creating waste in the first place, and looking for opportunities to turn waste from other places into a resource. For buildings, this includes:

- refitting and refurbishing existing buildings rather than building new
- designing-out waste arising during construction
- using reclaimed materials and components in design
- applying lean design principles to reduce demand for resources and associated waste.

This chapter covers each of these ideas, along with case studies that show how different elements of these principles can be applied.

Refit and Refurbishment

The greenest building is the one already built.

Attributed to architect Carl Elefante

When deciding whether to refurbish an existing building or to rebuild, the constraints of the existing building are often cited as the reason for demolition. Typical issues are the floor-to-ceiling heights, riser space or the floor layout. There is also often a financial incentive to build new, as this can increase yields and, in the UK, the tax regime offers little incentive to developers to refurbish existing buildings.¹ On the other hand, there are many situations where buildings are refurbished instead of being demolished and the designers work around these constraints. In the UK, some developers have built their business models around refurbishing existing buildings into attractive places to live and work.

The Tea Building and the 'White Collar Factory', London

For Derwent London, breathing new life into old buildings is a central tenet of its business model. It aims to reuse as much of the fabric of the original building as possible to reduce resource use, time on site and to save money. The Tea Building in



Figure 7.01: The Tea Building in Shoreditch, London.



Figure 13.04: Bosch Siemens building atrium with green wall.

The construction industry, on the whole, operates within a linear economy of make, use, dispose. But with common materials becoming ever more expensive to procure and rare earth elements becoming increasingly scarce, it is time to apply a more effective model.

The principles of the circular economy are already being used by other industries, and in recent years both the UK Government and the European Commission have promoted the model as the most sustainable option for the future. Yet despite this emphasis there has been little focus on how construction industry professionals and their clients can contribute towards the movement.

Building Revolutions addresses this absence: drawing on illustrative methods and examples, the author explains in simple and practical terms how the principles of a circular economy can be applied to the built environment, thereby reducing the resources required to construct, fit-out, maintain and refurbish buildings.

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“Buildings as material banks, energy generators and service providers... The future of architecture and construction will play a key role in the transition to a circular economy, and David Cheshire’s book makes a compelling case for a profound rethink.” – **The Ellen MacArthur Foundation**

“I welcome the work David Cheshire has put into articulating a different future for an industry with so much potential for greater efficiencies.” – **Julie Hirigoyen, CEO, UK Green Building Council**

