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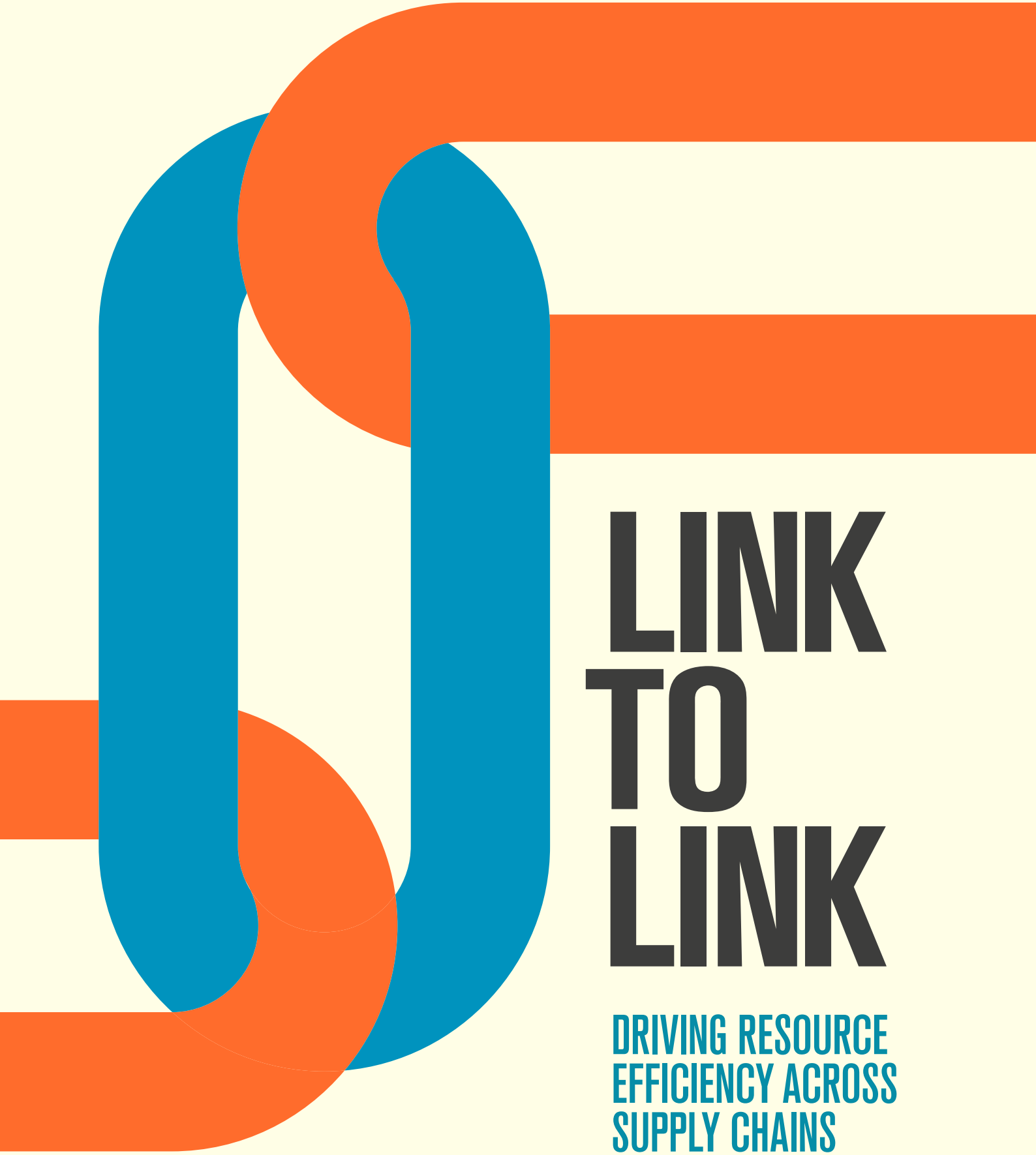

# LINK TO LINK

## DRIVING RESOURCE EFFICIENCY ACROSS SUPPLY CHAINS

**Link to Link: Driving Resource Efficiency across Supply Chains**

February 2016



This publication was kindly supported by SUEZ, WRc and GJF Fabrications Ltd and compiled by:

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The UK needs to move towards a system where the entire supply chain of products moves towards the circular model. The old model of make, use, dispose cannot continue, and this is true of all sectors in the UK, not just the environmental services and waste industries.

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# FOREWORD

**Barry Sheerman MP** and
**Peter Aldous MP**

The sustainable resource or ‘waste’ industry continues to be a great success story for UK plc. Despite economic challenges, first with the economic downturn from 2008 and now through fluctuating secondary raw materials prices, the industry continues to innovate and accept challenges faced both at the frontline and with potential systems change around the circular economy looming on the horizon. However, while embracing the need for change and innovation the waste and resources world will face further challenges in the future in its efforts to encourage industries across the entire supply chain to embrace sustainability and become more resource efficient.

The subject of resource use is now attracting the public interest as can be seen by increased prominence in national news: stories about plastic litter in our oceans, the decline of the steel industry, 'wonky' vegetables, and England's recent single use plastic bag charge are just a few examples of stories that have made headlines in the past year. Whilst a continued focus on sustainably processing waste and resources at their end-of-life stage is always important, the UK needs to move towards a system where the entire supply chain of products moves towards the circular model. The old model of make, use, dispose cannot continue, and this is true of all sectors in the UK, not just the environmental services and waste industries.

In this essay collection, the All-Party Parliamentary Sustainable Resource Group (APSRG) has brought together a wealth of knowledge on how increased resource efficiency, waste reduction and material circularity can be achieved at all stages of the supply chain, this includes procurement, product, service and business model design, data management and end-of-life processing. It also argues that increased resource efficiency not only improves an organisation's environmental footprint but can provide a true benefit to businesses' triple bottom line. But for this to happen, both the industry itself and the government need to make some changes.

There is much more that government can do to support the organisations already making positive efforts to improve their resource efficiency, as well as encouraging further businesses and industries to take up the challenge. But it is not for government to do alone. This collection of essays will try to stimulate new thinking and inspire both industry and government to consider the environmental impact of their supply chains, and encourage more collaboration and shared best practice to improve resource efficiency and solidify their businesses whilst moving toward a more circular economy.

**Barry Sheerman MP**
Co-Chair

**Peter Aldous MP**
Co-Chair

# INTRODUCTION

**Anne-Marie Benoy**
Senior Researcher
APSRG

Whilst there have been some successes in the waste and resources industry, there remain key challenges for end-of-life parts and products. How can all of the industries along the supply chain, so vital in moving towards a more resource efficient economy, be inspired to embrace the new opportunities presented to them by moving to circularity and engaging with the waste and resource sector? And how can resource efficiency be more encouraged at all stages of the supply chain, not just at end-of-life stage?

The challenge of addressing resource efficiency at all stages of the ever-globalised and complex supply chain is substantial; however, the UK is continuing to innovate and develop new thinking about how to solve this complexity. This APSRG essay collection aims to enhance exactly this debate. As submissions to this essay collection showcase, incorporating resource efficiency from a supply chain sustainability perspective will be key in moving towards a more circular economy. Acknowledging this issue using the language of supply chains management will also be vital to inspire new actors and industries to come on board in this transition.

Communication and collaboration will therefore be key. The greatest challenge, but also potential, of improving material resource efficiency across various stages of the supply chain will be in linking the value chain – e.g. designers, manufacturers, logistics, consumers, waste managers – both practically/professionally and in terms of communication and sharing innovation.

> Moving towards a more circular economy will require systemic change with many different actors pulling at the same strands and engagement from various government departments. As such, it will also be important to consider the entire product lifecycle at policy level.

With contributions from key thinkers from the civil service, academia, industry and the third sector, key issues around resource efficiency at various stages of the supply chain have been identified and best practice examples highlighted. The barriers which are currently stopping both large companies and small and medium enterprises (SMEs) from making their supply chains more sustainable, circular and resource efficient are investigated and key policy recommendations made to both business and government as to how to overcome these challenges.

The collection has been compiled following findings of the APSRG and All-Party Parliamentary Manufacturing Group (APMG) report *Triple Win: The Social, Economic and Environmental Case for Remanufacturing* (December 2014) and observations made during APSRG events around concerns that supply chains can hinder but also aid improved resource efficiency. In the 2014 report, we saw how remanufacturing presented opportunities for supply chains at a number of levels including design, business model development, procurement, logistics and consumer choices.

Now, in this new report, we aim to make a case that the interdisciplinary nature of this subject presents a huge opportunity both environmentally and financially. As discussed in Chapter 1, there is already the demand from manufacturers and the waste and resources sector for the right kind of intervention by government and policy makers to align public policy with the motivations of industry. This report aims to inform and simplify this policy change.

## The Circular Economy

Alongside the positive impact a more resource efficient and circular economy could have on the natural environment, primary raw materials and the climate, businesses and governments are also becoming increasingly aware of the financial gains that can be experienced when moving towards a more circular economy.

The concept of a circular economy has deep-rooted origins and it is difficult to trace back to a single date or author. It has been influenced by many schools of thought including Cradle to Cradle, Biomimicry, Regenerative Design, Industrial Ecology, the Performance Economy and the Blue Economy[1]. Although its practical applications gained momentum alongside the concept of sustainable development in the second half of the 20th Century, the concept has gained particular strong impetus since the beginning of the 21st Century.

> Following the publication of the recent EU *Circular Economy Package*, the European Commission outlined that "in a circular economy the value of products and materials is maintained for as long as possible; waste and resource use are minimised, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value".[2]

The Department for Environment, Food and Rural Affairs (Defra) recently developed a diagram of the Circular Economy (Figure 1) that powerfully portrays the many layers or levels at which circular or non-linear production and consumption methods can be practised. The diagram also incorporates a waste hierarchy by showcasing that the repurposing of materials and products becomes more environmentally desirable as you move closer to the core of the diagram.

It is exactly this kind of circularity showcased in Figure 1 that needs to be incorporated and considered in the decision making process at the many stages of supply chains in order for industry and supply chains to become more environmentally sustainable, resource efficient and economically robust.

## Supply chains

> A supply chain can be defined as the network of all the individuals, organisations, businesses, resources, activities and technologies involved with the creation and sale of a product.[3]

Supply chains originate with the delivery of source materials (either raw or secondary) from supplier to manufacturer, and continue to delivery through various stages of assimilation, whole sale, retail and delivery to the end user. Incorporating circular economy discourse in supply chains thinking involves acknowledging that traditional 'consumers' are actually not the end users of products, but that reprocessing and re-circulating materials and products are imperative for environmental, economic and social reasons. Supply chains are multi-faceted, interdisciplinary, complex and multi-layered systems and are becoming increasingly complex in our globalised world economic system.

1 Ellen MacArthur Foundation (2015). Available at: http://www.ellenmacarthurfoundation.org/circular-economy/schools-of-thought/cradle2cradle
2 European Commission (2015) Circular Economy Package: Questions & Answers. Available at: http://europa.eu/rapid/press-release_MEMO-15-6204_en.htm
3 Kahraman, C. and Oeztay, B. (2014) Supply Chain Management under Fuzziness: Recent Developments and Techniques (eds). Springer: London.

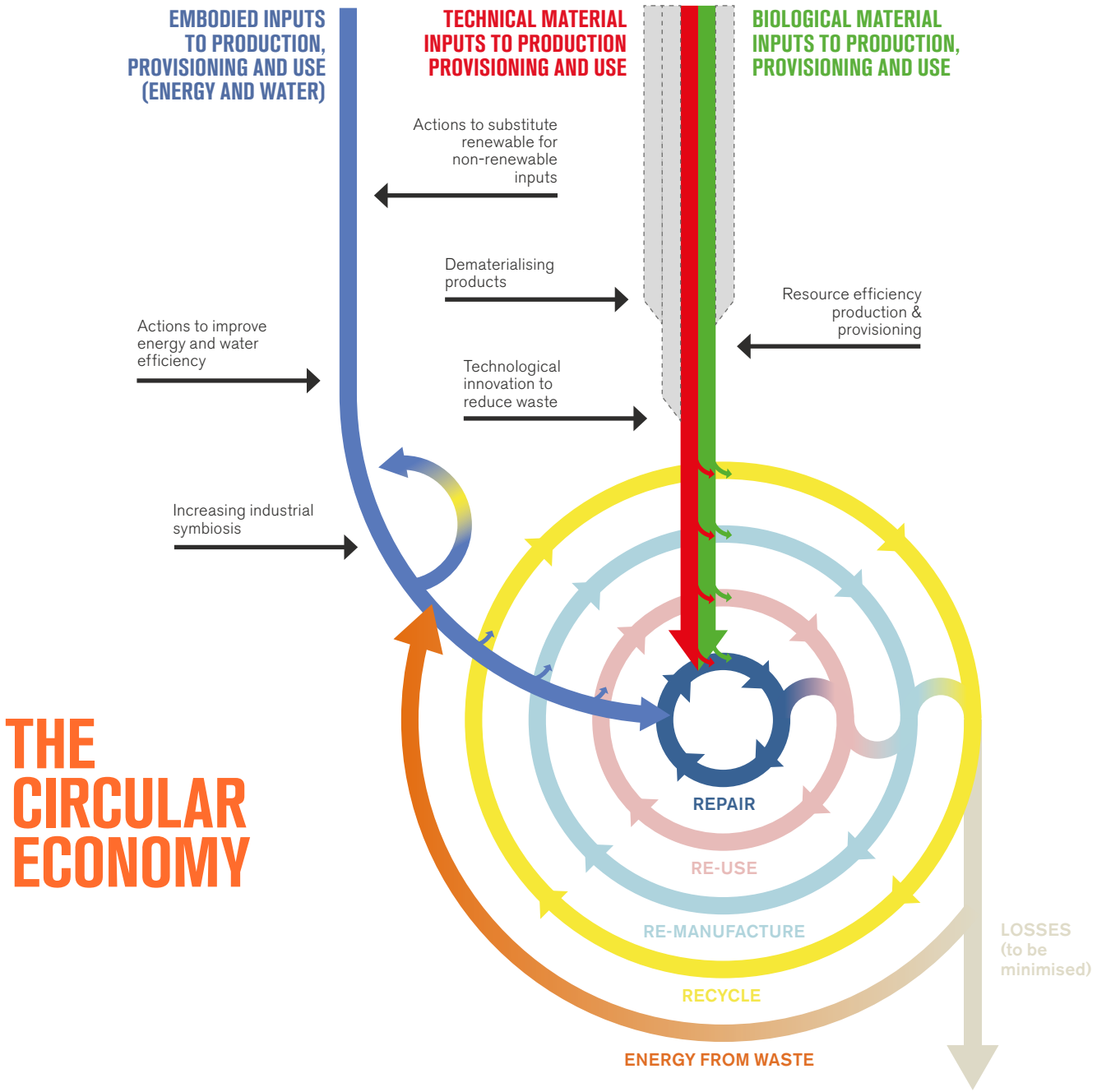



Figure 1: A diagram of the Circular Economy as developed by Defra, until now unpublished.[4]

Although supply chains are increasingly understood to be gateways to more sustainable business development, in terms of materials resource efficiency, many more opportunities for improvement remain. Businesses and government have a long way to go to take advantage of the economic, environmental and social opportunities that more sustainable supply chains present.

4 Davies, L, (2015) A Diagrammatic Representation of the Circular Economy Concept. Department for Environment, Food and Rural Affairs (Defra).

# The essay collection structure

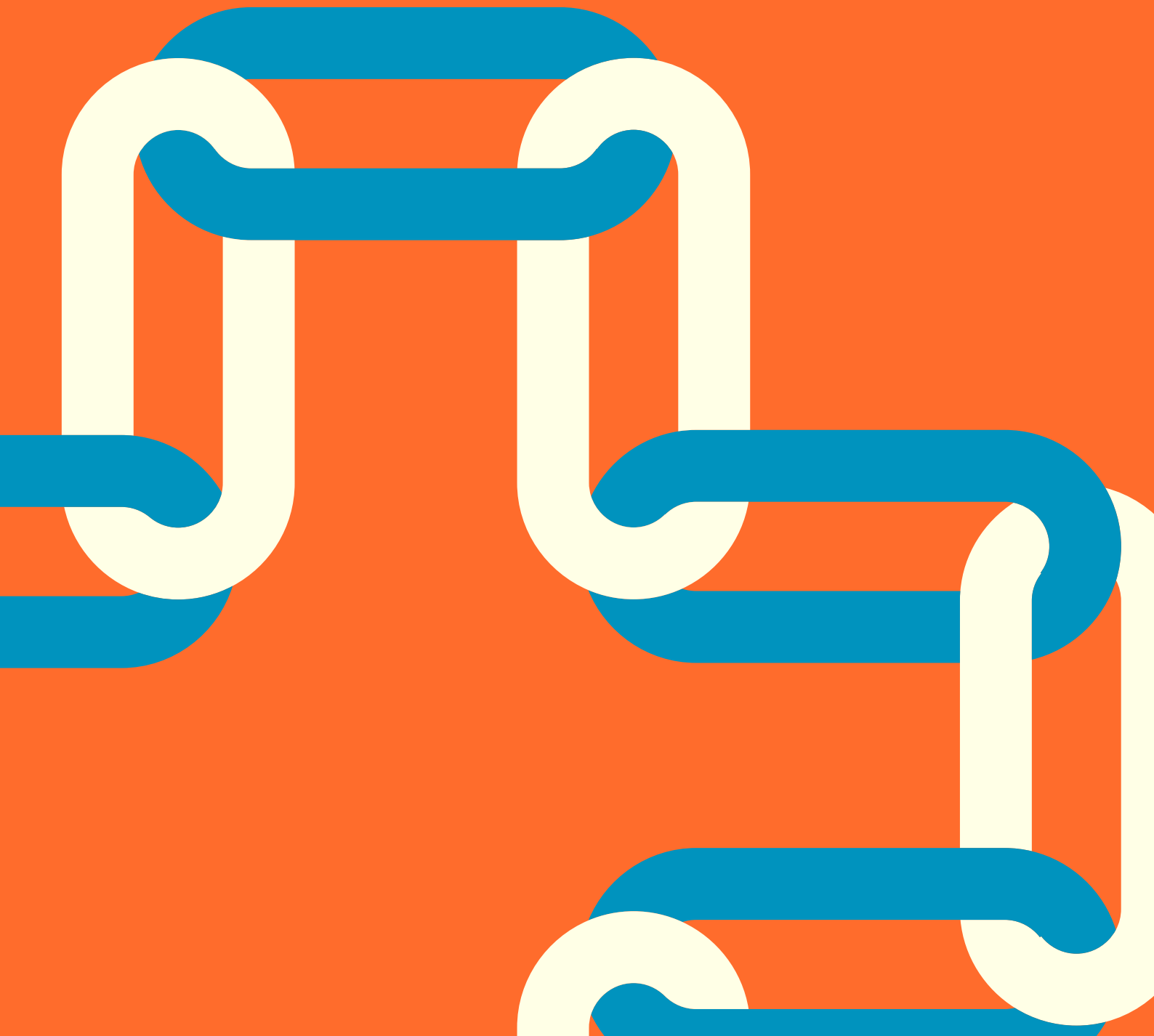
The structure of this essay collection follows the general outline of a circular or non-linear supply chain that aims to reduce, reuse, refurbish, recondition and remanufacture materials and products at their end-of-life stage to move towards a more resource efficient and sustainable production and consumption system.

- In Chapter 1, Dr Gev Eduljee (SUEZ) provides an overarching summary and discussion of the issue at hand, showcasing our aim not to present any of these stages in silos;
- Supported by case studies from Feedback and WRc on how procurement practices continue to drive innovations in the food waste and utilities sectors respectively, Liam Fassam (University of Northampton) argues in Chapter 2 that promoting the systematic adoption of Green Procurement policies will provide the UK with its single biggest 'quick win' in its transition to a resource efficiency circular economy;
- Eighty percent of the environmental burden and cost of a product is fixed at the design stage of the supply chain. In Chapter 3, Dr Kurt Yang Liu (Northampton Business School) explains that much of this environmental burden of products relates to waste and resources;
- Logistics is probably one of the most essential pieces of the puzzle to enable the move to more circular businesses practices, acting as a servant for other supply chain priorities. This is discussed with much vision and in more detail by Peter Jones OBE (Policy Connect) in Chapter 4 and put in context by case studies from Argos (written by its partner WRAP) and GJF Fabrications Limited;
- The Waste and Resources Action Programme (WRAP) has extensive experience in engaging consumers and businesses to make more resource efficient decisions. Penned by Patrick Mahon (WRAP), Chapter 5 outlines how to overcome the difficulties of delivering more resource efficient options to consumers and businesses;

- The importance of business model innovation to support the growth of remanufacturing was one of the key findings from the APSRG and APMG '*Triple Win*' report. In Chapter 6, Ben Peace (The Knowledge Transfer Network) builds on this discussion, stressing that technological innovation and communication are the keys when aiming to move to a new and innovative business model;
- Dr. Dominic Hogg (Eunomia Research & Consulting) outlines how in the ever-changing waste and resource industry, traditional waste companies have started to act like manufacturers and points to what their role will be in future circular supply chains (Chapter 7);
- Chapter 8, written by Dr Diego Vazquez-Brust and Prof. Laura J. Spence (Royal Holloway University of London), presents current knowledge and concerns around metrics, data management and sustainable accounting for measuring resource efficiency across supply chain stages, making the case that more clarification is needed in the area of efficiency indicators both at government and industry level;
- Finally, in the conclusion chapter, the APSRG pulls together specific recommendations for both government and industry to improve resource efficiency. It also highlights the importance of SMEs to the UK economy and lists them as a case for careful policy attention.

# CHAPTER 1: OVERVIEW

**Dr Gev Eduljee**
External Affairs Director
SUEZ



## Definitions

Resource efficiency is a slippery concept. While seemingly intuitive, a precise definition is elusive. In a survey of 31 countries, including the EU-27, the European Environment Agency (EEA) reported that "there is neither a clear definition nor a common understanding of key terminology"[5]. Resource efficiency was used interchangeably with decoupling (from consumption), sustainability, sustainable use of resources, minimising use of natural resources, eco-efficiency, the green economy, and the circular economy. Even the term 'resources' covered one or more of raw materials, energy sources, biomass, waste, land, air, water and biodiversity.

Depending on one's world view, an industrialist is likely to regard resource efficiency as a means of reducing costs and improving the bottom line of the business (a view shared by Defra[6]), an environmentalist as the preservation of natural capital while limiting environmental damage, and as a vector for equitable sharing of scarce resources, and a policymaker as a framework for setting strategic objectives for resource security to safeguard the national economy. Each standpoint is valid but not necessarily optimal if other considerations are excluded. Recognising this, the EEA study accepted that there were both "advantages and disadvantages of providing clear definitions of… resource efficiency. One approach could be… to use broad interpretations of resource efficiency" to allow for flex in what aspects are addressed.

Kristof and Hennicke[7] articulate the aims of resource efficiency:

- Prevent or limit resource scarcities… that lead to economic dislocations [and] conflicts;
- Reduce dependence on imports;
- Curb the negative macroeconomic and social effects of global price rises and price volatility;
- Contain environmental problems that arise from excessive consumption and strain on sinks;
- Prevent social problems associated with resource extraction/exploitation (e.g. child labour);
- Ensure fairer distribution e.g., between 'North' and 'South' and between generations.

The link with related concepts such as sustainability, social justice, intergenerational equity and social responsibility is apparent. Though a precise distinction is not obvious, this suggests that resource-efficient practices should include an economic/financial dimension (e.g. cost reduction) within an environmental and ethical framework, elements of which are explored in Chapters 4 and 10.

5 European Environment Agency (2011) Resource efficiency in Europe, EEA Report No. 5/2011.
6 Defra (2015) Resource management: a catalyst for growth and productivity. WIDP programme Office.
7 Kristof K and Hennicke P (2010) Final report on the Material Efficiency and Resource Conservation (MaRess) Project. Resource Efficiency Paper 0.4. Wuppertal Institute.

A definition applicable to the management of resources in supply chains is given by the EEA[8]:

> "... Activities aimed at or effecting the efficient use of material resources throughout the economic system including resource extraction, product design, production systems, distribution, consumption, re-use, waste prevention, recycling and disposal."

A definition of the circular economy[9] - "a production and consumption system that generates as little loss as possible" - points up the link with resource efficiency.

## The policy context

Resource efficiency in the context of reducing process costs and increasing industrial productivity has been standard practice since the late 1940s. Examples of well-established production and management optimisation techniques include lean (eliminating waste and reducing the quantity of resources used – see Chapter 5), Factor 4 (twice as productive with half the materials and energy resources) and Six Sigma (process improvement to increase productivity, reduce wastage and costs, and increase profits).

Resource efficiency as a European and UK policy imperative is more recent, dating from about the mid-2000s in response to rising commodity prices and geopolitical maneuvering for control of critical raw materials. Building on an earlier policy initiative[10], Europe 2020, the European Union's ten-year strategy for "establishing a smart, sustainable and inclusive economy", identified a resource efficient Europe as one of seven flagship initiatives[11]. Under this initiative, a *Roadmap to a Resource Efficient Europe*[12] was published in 2011, the aim being "to achieve a more sustainable use of natural resources and [a] shift towards a resource-efficient, circular economy", with milestones extending to 2050. Note resource efficiency is regarded as synonymous with the circular economy. The Roadmap sees increasing resource efficiency as "key to securing growth and jobs for Europe [bringing] major economic opportunities, improv[ing] productivity, driv[ing] down costs and boost[ing] competitiveness".

The Roadmap seeks to establish greater coordination of national and European policy on resource efficiency. A number of studies have been commissioned to examine Member State policies and to propose a coherent European policy framework. In addition to the EEA review referred to above, other EU-funded studies include those by Ecorys[13] , Ahtonen and Chiorean-Sime[14] , DG Environment[15] and the ongoing multi-partner programmes DYNAMIX[16] and POLFREE[17].

8 EEA (2005) European Topic Centre / Resource and Waste Management Implementation Plan 2006.
9 EEA (2014) Building a resource-efficient and circular economy in Europe. EEA Signals 2014.
10 Thematic Strategy on the Sustainable Use of Natural Resources (COM(2003)572)
11 Europe 2020: The European Union Strategy for Growth and Employment. COM (2010) 2020 Final
12 European Commission. Roadmap to a Resource Efficient Europe. (COM(2011)571)
13 Ecorys (2011) Study on the Competitiveness of the European Companies and Resource Efficiency. DG Enterprise and Industry
14 Ahtonen A and Chiorean-Sime S (2012) Green revolution: making eco-efficiency a driver for growth. European Policy Centre, EPC Issue Paper No.68.
15 DG Environment (2014) Cases of implementing resource efficient policies by the EU industry. Final report, 28 November.
16 DYNAMIX: Decoupling growth from resource use and its environmental impacts. Available at: http://dynamix-project.eu/
17 POLFREE: Policy options for a resource efficient Europe. Available at: http://www.polfree.eu/

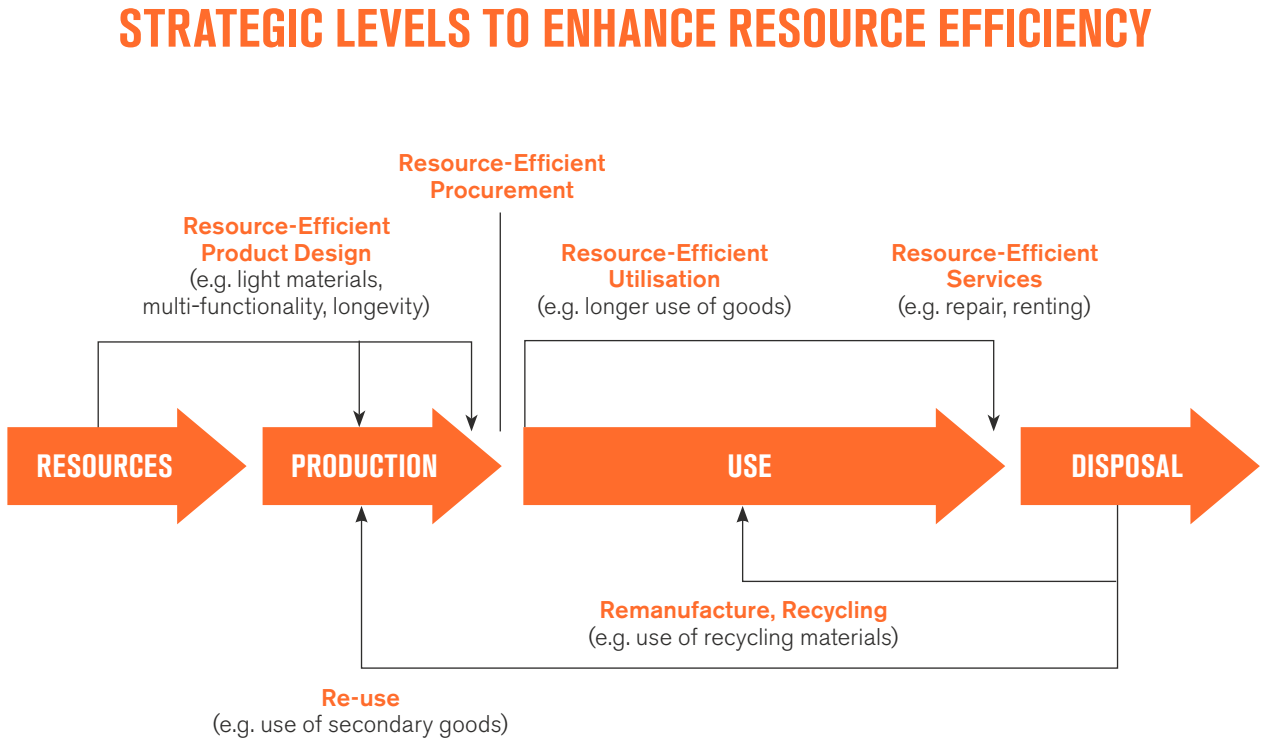



Figure 1: Strategic levers to enhance resource efficiency
Source: Adapted from Scholl G (2010) Consumer-oriented approaches to foster resource efficiency

In this context, the framework underpinning policy development can perhaps be more accurately described as a materials chain or a product lifecycle (resource extraction → production → consumption → disposal → re-introduction as a secondary resource) as opposed to a supply chain, the main distinction being the general absence of logistics as an explicitly defined link in the chain (see Chapters 3 and 6).

A consistent insight arising from these studies is that the most effective policy mix is one that addresses the entire product lifecycle, as illustrated by Scholl[18].

The POLFREE project adopts a similar framework. In relation to policy mixes addressing resource efficiency and a circular economy, three policy instruments in particular were selected from a long list[19] , which chime with the strategic levers proposed by Scholl:

- Incentivise a more resource efficient product design by individual producer responsibility;
- Specify eco-design requirements that make reuse and repair of products economically viable;
- Establish waste targets that focus on the production of high quality secondary resources.

Chapters 5, 8 and 10 pick up on these themes.

18 Scholl G (2010) Consumer-oriented approaches to foster resource efficiency. MaRess Project, Resource Efficiency Paper 12.8. Institute for Ecological Economy Research, Berlin.
19 POLFREE (2014) Policy mixes for resource efficiency. Deliverable D2.3.

## Policy and business

Alignment of the commercial interests of businesses to the wider environmental concerns inherent in the resource efficiency concept is work in progress. Frontrunners recognise the benefits and are up for the challenge[20]. But a survey of 1,000 leading CEOs[21] found that while remaining fully committed to sustainability as a business goal, many CEOs had taken their companies as far as they could, given the structures, incentives and demands of the market. Eighty four per cent of CEOs interviewed called for hard intervention by governments and policymakers to align public policy with sustainability, with instruments such as regulations, standards and tax measures.

> These are measures that only governments can introduce. Hence the role of government is critical to ensure that companies aspiring to greater resource efficiency (in the wider sense of the term) receive market and price signals which reward circularity while dis-incentivising linear behavior.

In essence, regulatory intervention is essential to underpin and support company-initiated resource efficient supply chain initiatives. Because of today's complex and global supply chains, these measures should preferably be introduced on a pan-national basis.

## Resource efficiency in the supply chain

The UK has been measuring its journey towards resource efficiency for many years, mapping GDP against Domestic Material Consumption, DMC (Domestic extraction + Imports – Exports). The most recent statistics are presented in Figure 2. On the basis of a comparison with the EU-27, the UK government states that "this possibly suggests some weakening in any link between economic growth and DMC" – a qualified endorsement at best, of the UK's progress towards absolute decoupling of economic growth from resource use.

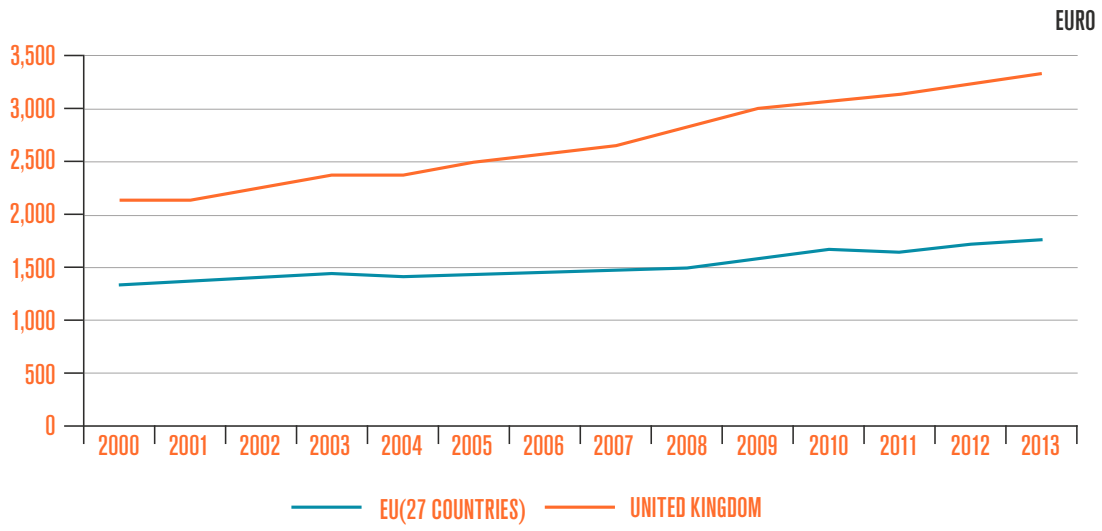



Figure 2: GDP per tonne of DMC, EU-27 and UK, 2004-2013
Source: DEFRA (2015) Digest of Waste and Resource Statistics – 2015 Edition

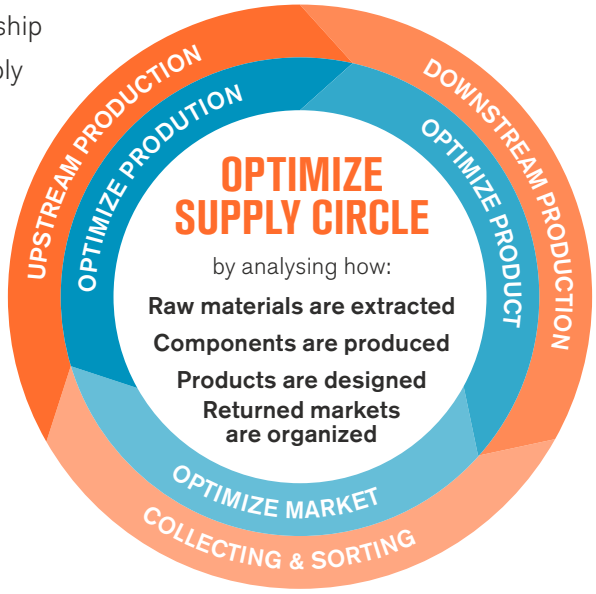
20 World Economic Forum (2012) More with Less: Scaling sustainable consumption and resource efficiency.
21 The UN Global Compact–Accenture CEO study on sustainability (2013) Architects of a Better World.

At a company level, early studies quantified the savings opportunities from reducing waste arisings and improving energy efficiency[22, 23]. The 2003 study concluded that if the manufacturing sector in England and Wales invested £1.5 billion in best-practice techniques, they could achieve waste savings of £2.4 billion in annual operating costs, over a payback period of less than 8 months. These studies have been updated, the most recent estimating resource efficiency savings of £55 billion across the UK economy for 2009, focusing on efficiency programmes in energy, water and waste[24].

Insofar as a resource efficiency 'sector' can be identified, the Technology Strategy Board (now Innovate UK)[25] estimated the market value of the goods and services supporting industrial resource efficiency programmes at £50 – £75 billion. The market value of specific segments such as remanufacturing has been estimated at £2.4 – 5.6 billion[26].

As noted above, these and case studies across Europe[27] tend to limit the boundaries to their resource efficiency programmes, focusing on production-related parameters such as energy, water and/or waste. Mohr et al[28] point out that "to realise the full resource productivity opportunity, companies need to work across the full supply chain", as shown in Figure 3. The concept chimes with the policy mix depicted in Figure 1 and is in line with the approach taken in this set of essays.

- Rethink resource ownership
- Develop sources of supply via return markets




- Help downstream collectors and sorters to optimise return of materials/components
- Help upstream suppliers optimize production

- Explore new recovery techniques
- Develop markets for recovered materials

## HOW TO DO IT

- **Exercise Influence** in the supply circle where there is no direct control – both upstream and downstream
- **Consider New Business Models** for example, lease rather than sell to retain ownership of materials embedded in products.

Figure 3: Resource efficiency – a supply chain approach[24]

22 Defra (2002) The Energy Review.
23 Cambridge Econometrics and AEA Technology (2003) The Benefits of Greener Business.
24 Defra (2011) The Future Benefits of Business Resource Efficiency. March 2011; Final report.
25 Technology Strategy Board (2009) Resource Efficiency Strategy 2009-2012
26 All-Party Parliamentary Sustainable Resource Group (2014) Remanufacturing: Towards a resource efficient economy.
27 DG Environment (2014) Cases of implementing resource efficient policies by the EU industry. Final report.
28 Mohr S, Somers, K, Swartz S and Vanthournout H (2012) Manufacturing Resource Productivity. McKinsey Quarterly.

The question arises as to why, given the potential savings achievable, companies do not pursue resource efficiency measures with greater alacrity. In fact companies do, but generally in the context of immediate savings across their manufacturing and production lines – for example, sourcing cheaper raw materials. This is hardly surprising. Small and Medium Enterprises (SMEs; any business with fewer than 250 employees) account for over 99% of the 5.4 million registered businesses in the UK, while 5.1 million SMEs are micro-businesses (employing 0-9 people)[29]. With roughly half of SMEs failing after 5 years, the overriding priority of an SME is most likely to manage its bottom line by keeping day-to-day direct costs under control.

> Resource efficiency benefits from exercising the fact that wider ambit of actions (such as sustainable sourcing) are generally realised over the longer term and therefore typically not an immediate priority.

These latter actions tend to be taken up by larger, established companies with a more strategic view of resource efficiency, through their sustainability and Corporate Social Responsibility (CSR) programmes, emphasising the important role of apex companies in leading and driving comprehensive resource efficiency measures down their supply chains, in partnership with upstream suppliers. This theme is addressed in Chapter 4.

## Measuring resource efficiency

The complexity of supply chains and the wide range of resource efficiency measures that can be pursued make measurement daunting. Coupled with a comprehensive material flow tracking system and producer responsibility schemes, at a macroeconomic level Japan has distilled three simple input-output indicators, with metrics and targets[30]:

- Resource productivity (GDP/natural resource input);
- Circulation (recycling of waste as a function of total resource input);
- Final disposal amount of waste.

As part of its *Resource Efficiency Roadmap*, the European Commission is developing a layered set of indicators comprising one headline indicator (GDP/DMC) focusing on resource productivity, a dashboard of complementary macro indicators focusing on resource and its environmental impacts, and a set of thematic indicators to monitor policy effectiveness.

Chapter 10 describes models that can be applied at a company level. A key aspect of these models is measuring that they are multi-thematic, measuring material, financial and environmental performance to assess overall resource efficiency. The general principle is described by Mollenkopf et al[31] as optimising an integrated green, lean and global supply chain. With Material Flow Accounting (MFA) at its heart, Life Cycle Assessment (LCA), Cost Benefit Analysis (CBA) and Life Cycle Costing (LCC) are tools used to integrate the material, economic and environmental elements of resource efficiency[32]. Material Flow Cost Accounting (MFCA) has been developed into an EU standard – EN ISO 14051.

29 House of Commons Library (2015) Business Statistics. Briefing Paper No. 06152, 7 December 2015.
30 Takiguchi H and Takemoto K (2008) Japanese 3R policies based on material flow analysis. J Industrial Ecology, Vol. 12, pp 792-798.
31 Mollenkopf D, Stolze H, Tate W L and Ueltschy M (2010) Green, lean and global supply chains. J Physical Distribution and Logistics Management, Vol 40, pp 14-41.
32 Hoogmartens R, van Passel S, van Acker K and Dubois M (2014) Bridging the gap between LCA, LCC and CBA as sustainability assessment tools. Environmental Impact Assessment Review, Vol 48, pp 27-33.

In addition to the models described in Chapter 10, the Ellen MacArthur Foundation[33] has published a methodology and accompanying indicators to assess the resource efficiency and degree of circularity of a company's use of resources and its impact.

Most of these models, including those described in Chapter 10, are frankly beyond the capability of the average SME to use as mainstream decision-making tools. It is therefore with good reason that companies tend to take a layered approach to resource efficiency, focusing initially on issues within their control which provide the most immediate returns.

## The future

At the level of the operating business, companies will continue to strive towards greater resource efficiency; reducing raw material and utility costs, optimising production cycles, operating lean and cutting waste.

> A more comprehensive supply chain approach as illustrated in Figure 3 requires a different way of working – service providers and service users become supply chain partners, down to and including the consumer. Information and resource efficiency gains are shared so that each node of the chain is incentivised to build a win-win supply chain partnership.

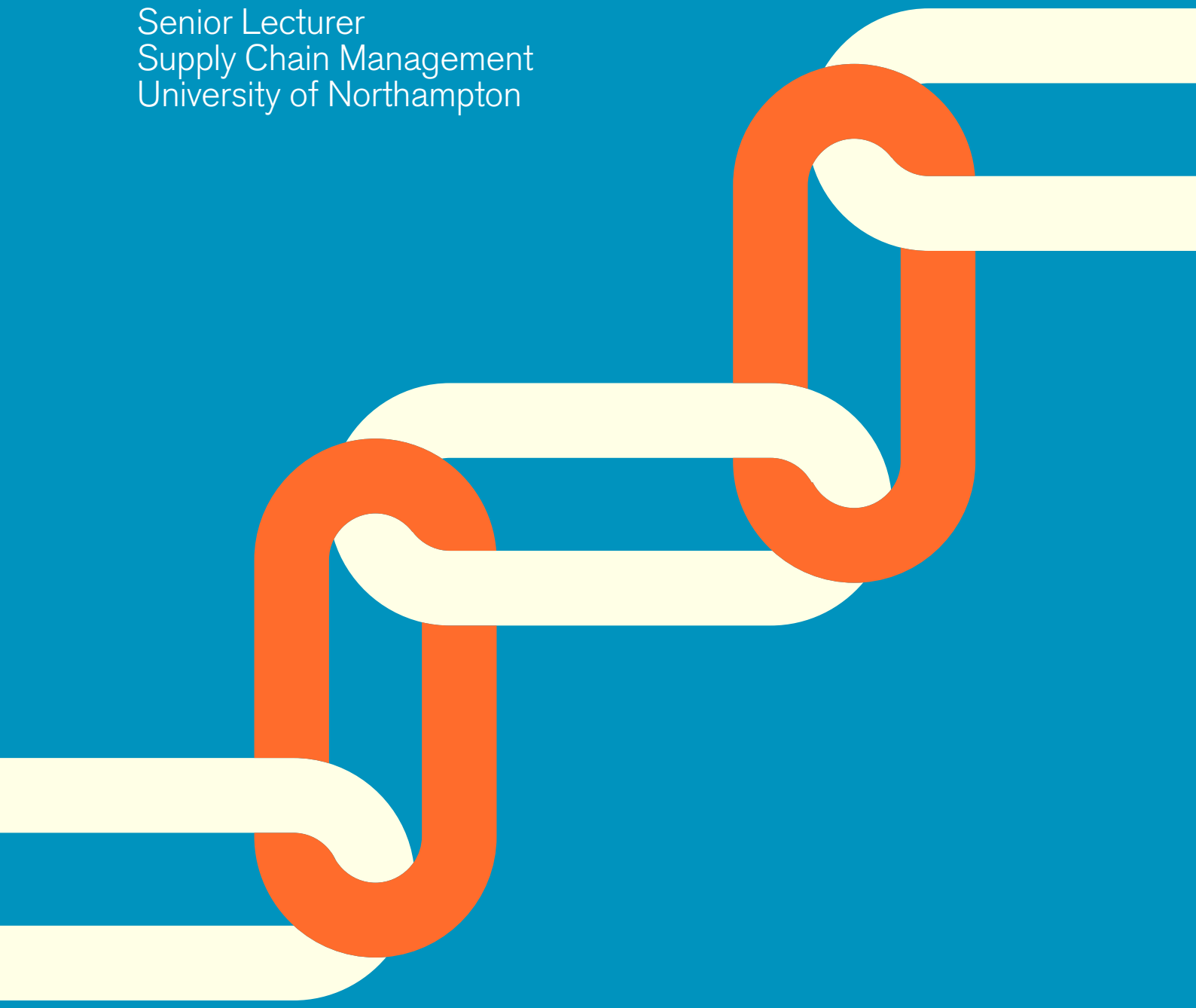
This approach is gathering momentum, as testified by the case studies in this compendium and by the public pronouncements of most of the leading international brands.

But there are limits to the extent to which individual companies can turn an entire economy around purely by influencing their respective supply chains. Until environmental concerns become fully embedded in day-to-day commercial dealing and are properly costed into goods and services, the economic signals will not be strong or visible enough for the average company spontaneously to change the way it does business and becomes more resource efficient. The role of policymakers in enabling this economic transformation should not be underestimated.

33 Ellen MacArthur Foundation (2015) Circularity Indicators: An approach to measuring circularity.

# CHAPTER 2: PROCUREMENT AND SUPPLY CHAIN RESOURCE EFFICIENCY

**Liam Fassam**
Senior Lecturer
Supply Chain Management
University of Northampton



Waste management has seen key developments in recent years. More and more, businesses must recycle, repurpose or reuse at every stage of their supply chain to minimise waste. But there are huge opportunities here for strategic procurement functions to deliver huge improvements through better understanding of materials, suppliers, processes and reverse logistics throughout the supply chain.

Although the scope of this chapter is not to deconstruct the auspices of every supply chain strategy, it will discuss some of the drivers, benefits and actors (Figure 1) of supply chain resilience and sustainability that is central to procurement functions, alongside the consequences pertaining to waste, creating more socially responsible, sustainable and ethical businesses as a consequence.

| Drivers | Benefits | Actors |
|---|---|---|
| Procurement policy | Long term efficiency savings | Human rights |
| Whole life costing | Effective use of natural resources | Labour rights |
| Challenge culture | Reduced pollution & waste | Environmental impacts |
| Create a sustainable procurement policy | Promotes innovation | Poverty eradication |
| Communicate & measure suppliers | | Governance |

Figure 1: Drivers, benefits and actors of supply chain sustainability

## Food waste – how procurement can help

Despite the poor track record on food waste, debates on sustainable food systems and waste have predominately centred on production processes, with little consideration as to impacts beyond the farm gate and the intricate and interconnected networks that lay beyond. Waste in the supply chain is unsustainable but in order to minimise it to the fullest extent possible, an in-depth, cross supply chain analysis is required. This will deliver decisive insights into supply chain actors. It is after this mapping has been undertaken that holistic supply chains foster synergistic relationships to reduce wasteage and look for alternative routes to market can materialise.

In order to achieve increased efficiency and lower costs, a coherent global process is required to deliver clarity around supply chain design. Historically, business has operated in a linear economy, one that has enabled holistic supply chains to operate on a make-buy-waste basis, without any need to consider the effects this has on ethics or society at large.

The UN purports a 25% reduction in food waste would eradicate the upcoming challenges associated with food security and sustainability. Every year 1.3 billion tonnes of food gets wasted, equating to a third of global production, while 795 million global inhabitants experience hunger and malnutrition. Alongside the food waste challenge, global consumer trends are changing and this is placing a strain on sustainability in a supply chain context. For example, the average person in China consumes 57kg of meat per annum, an increase of 25% over the previous decade, with an anticipated increase of an additional 50% over the next ten years. This is predicted to have a knock-on effect on demand for cattle feed (grain) of 94 million tonnes, on top of the current requirement of 650 million tonnes per annum. As a society we are heading for the perfect storm, where consumer demand and waste inhibits supply and creates an unsustainable supply chain, unless procurement functions can effectively drive change.

## Why procurement?

It is the procurement functions of today's business that are best placed to undertake the function of driving ethics and sustainability. However, as public sector procurement has been proven to harness the ability to establish economic, environmental and societal models for others to emulate, it must take the lead on informing the future of ethical and sustainable supply chain operations (Day, 2005). In addition, both public and private sector procurement functions have been identified as best placed to effect development and adherence of sustainable policy processes and targets (Sommino, 2010).

Continuing with food as an example, the sustainable food supply chain pertains to food origins, production methods, transportation (logistics) and final destination. The latter [final destination] according to the Waste Resource Action Plan (WRAP), has a resultant 4.2 million tonnes per annum of avoidable food waste within the UK (WRAP, 2012). Procurement has a critical role to play in dealing with this 'avoidable' waste, as the linear business model (make-buy-waste) concentrates decision metrics on 'best value' or 'economically profitable tender', both of which inform public contracts within the EU. In the eyes of 'linear economy' procurement professionals this is interpreted as 'lowest cost' and does not give any regard to the ethics, source, health and wellbeing or the holistic agri-food value chain. Therefore, one could argue that;

> Although procurement has the proven rigor and structure to lead change in a supply chain, more needs to be done to change cultures within these decision-making departments, to embrace 'softer' elements of business decisions to bring holistic benefits in terms of waste reduction, which arguably brings cost reductions.

## Mitigating the supply chain risk through data

In order for procurement to effect decisions on the supply chain that will inform more sustainable practices and reduce waste, data acquisition and sharing of that data is key. A traditional farm to fork food supply chain operates on a forecast, which in the case of food originates 'downstream' (toward customer) with a retailer. Food retail forecasts will be based on but not restricted to market trends, consumer demands

and expected market uptake (in case of new product introductions). However, rarely do these forecasts pass fully 'upstream' to the producer of raw material i.e. farmer. Taking the example of planting oats for UK cereal producers – the forecast lead time is habitually 18-month in advance of harvest. During this time, consumer tastes can change, prices due to other commodities such as oil differ and weather events can affect a harvest. Collectively, these events are known as 'supply shocks'. It is these supply shocks that procurement departments work to mitigate. However, if a supply shock occurs in the current linear economy little is done to inform upstream actors of the change in demand. In the rare instance this does happen there is scarcities of 'other' options available for product re-use, therefore the product becomes waste, despite still holding a nutritional benefit. Consequently, by not sharing 'real time' data and implementing alternative routes to market for this material, we can determine this as an avoidable waste.

With a growing global demand for food, any supply chain with avoidable waste can be classified as inefficient. One would argue however that procurement departments should work with their upstream suppliers, which for the European food industry comprises 90% small to medium enterprises (SMEs). However, SMEs have little resource capability to find alternative routes to market or uses for their product. It is therefore incumbent on government and larger corporations to support redeployment of what would be traditionally termed as 'waste' in the linear economy and adopt a more circular approach. Some sectors would argue that this requires a separate logistics infrastructure and therefore additional cost, however this argument is flawed if we examine the amount of empty vehicles that currently reside within logistics and the huge inefficiencies in deep sea containerised shipping.

The aforementioned challenges of a linear economy not only affect the local economy, but cause a ripple effect across our global trading communities. Harnessing 'real time' information on supply chain activity will not only reduce avoidable waste but further mitigate food security challenges by diverting or finding alternative uses for food stocks, but furthermore ease price shocks and reduce food mountains.

## Intelligence and collaboration, reduced waste and fraud

Arguably, the sharing of data and intelligence is a tried and tested method within law enforcement agencies. Why then are supply chains not adopting this tried and tested approach to their business operations? With the amount of waste being generated across the European Union, it can be argued that shared data on resource availability would assist procurement professionals in being able to re-use product, rather than rely on new and limited resources. After all waste in a linear economy is seen a valueless product, the circular economy forces us to view wastes as a product with value.

A database of resource availability, separated out by category and updated automatically through enterprise planning systems would greatly assist procurement professionals in making informed decisions. Quite often a business will repurpose or reuse material that is a by product of another manufacturing process. This would be particularly the case if this was a reliable source and supported with robust logistics networks. Data could act as a facilitator of 'waste exchange' and further support reverse logistics operations.

Another function of data in procurement departments to reduce waste is the mitigation of fraudulent activity (Fassam et al, 2015). As demand for food increases and the UKs reliance on imports becomes greater, the visibility within our food supply chains will diminish unless steps are taken at government level to facilitate cross border sharing of information. This sharing of information will not only impact on enhanced health and wellbeing risk reduction by having greater surety of product, it will further reduce waste. This will occur as each time a fraudulent activity is detected the product is deemed as 'waste' and mitigation of such activity through shared use of data would therefore arguably reduce wastage and assist procurement departments and consumers alike by way of greater visibility.

## Many layers of suppliers/tiers – creates complexity and waste

The United Nations procurement handbook (UN, 2012) suggests that key barriers to achieving sustainable procurement are related to historically-ingrained cultural practices. This generates complexity of contracts which cut across every element of the supply chain, from sourcing of raw materials, flowing through the varying logistics nodes that support holistic value chains, to the downstream elements of consumer use. The myriad of different cultures, languages and contracts operating across the very long supply chains in our globalised economies are a recipe for disaster. Overly complex procurement contracts are habitually the default position to counteract communication and cultural challenges, but content gets lost in translation and is (being blunt) a box ticking exercise, adding little value to the overall holistic supply chain.

In a procurement context, Western based businesses quite often assume all actors in the chain will understand 'their' roles and responsibilities in bringing holistic benefit to all on the global stage. A current example is the modern slavery act, whereby all businesses with a turnover above £36 million are annually required to ensure their global supply chains are free of slavery. However, in a globalised context this is difficult to ascertain and police, as within certain cultures, it is acceptable to utilise human beings in a manner than contravenes human rights. How does this affect waste? Waste comes in many guises, from physical material to wasted resource. Organisations that understand this concept and utilise their procurement functions to work collaboratively with suppliers horizontally will foster ethical, sustainable and transparent supply chains, which arguably foster the ability through engaged suppliers to effect greater resource efficiency and thus reduce waste and deliver greater global societal good.

According to research on the effects of supply chain waste and procurement (Fassam et al 2015), complexity was found repeatedly across procurement functions, with predominate focus placed upon Tier 1 suppliers and the remainder of upstream tiers (toward raw material) were not considered. Frequently, outsourcing of a process is undertaken to lower cost and mitigate risk, and as such responsibility and tracking of supplier adherence to specifications are now external from the organisation. Examples of this are frequently seen within the food retail supply chain, whereby retail companies place orders with Tier 1 suppliers, handing over all risk and responsibility for the subsequent processes and having little visibility from there on in. This was the case with the horse meat scandal of 2013, whereby retailers outsourced their 'output risk' due to price and demand, thus loosing all control of their business processes and

as a consequence suffered 'input risk' due to fraudulent behaviour causing excessive wastes in a supply chain.

Transfer of liability that organisations can rely on to mitigate risk is a symptom of the outsourcing culture that businesses have gone through since the mid 1990s. This has eradicated the visibility needed in a supply chain context to bring true closed loop and sustainable supply chains to the fore. However, there is a global shift to near-shoring or re-shoring, with manufacturing shifting closer to end consumers in a bid to manage demand. As such, both barriers to supply chain success and culture should instigate a shift to the way risk is managed. This will allow procurement departments to have greater sustainability and visibility across its many tiers. As such, this will oblige government to look closer at the reasons why companies take manufacturing or sourcing outside the confines of the UK. Understanding this shift and implementing measures to re-shore will reduce exposure for UK businesses and as such lower waste.

## Conclusion

In conclusion, there is currently a global business community that is driven by cost metrics, with outsourced risk policies, and procurement functions that have little insight into demand and production. Further, there are limited and diminishing material resources and a research gap in the area of sustainable procurement. Additionally, the European Commission has issued a call to gain 30% efficiency over current supply chain processes and a United Nations report that indicates that as a global community we are at a standstill. As such, soft encouragements for more sustainable procurement have been set in stone, but practical suggestions for developing this at a wider scale nationally and internationally remain to be explored.

> It has been found that procurement is best placed to effect change and deliver governance to holistic supply chains, with the public sector leading the way as an exemplar of what good practice looks like in a business context.

An overriding requirement is needed to foster greater sharing of information across supply chain actors in order to reduce waste and make supply chains more resilient and sustainable. The marketplace is crowded with SME's all of which are looking for alternative routes for products or different sources of raw material and the creation of logistics industrial symbiosis and leveraging off of the current logistics networks is a way around this. Furthermore, this investment will not only foster a resource efficient economy, it will stimulate growth, innovation and skills development whilst meeting ethical and societal needs.

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# CASE STUDY: FEEDBACK

## EDD COLBERT
## CAMPAIGN & RESEARCH COORDINATOR
## FEEDBACK

An average of 44.5% of food grown in Kenya for European markets is rejected because it is the wrong size, shape or colour for European retailers[34]. Yet there is a seasonality to these rejections: when global productivity is high, rejections increase despite produce quality being at its highest. Research conducted by Feedback shows how British retailers and importers will often use cosmetic specifications as pretence for order cancellations. In effect, cosmetic specifications are used as a pressure valve to control the volume of produce procured by buyers when cheaper produce becomes available on the global market.

Unfair trading practices (UTPs) such as last minute order cancellations and retrospective changes to supply agreements result in the rejection of entire consignments of edible food after they have been grown, harvested, processed, packed and sometimes even exported. Local markets are either non-existent or economically unviable, so much of this food is wasted meaning farmers aren't paid. Exporters and farmers have to bare the entire cost of this waste, limiting their capacity to invest in innovation and expansion of their businesses. In addition, the reduction of income forces many farmers into cycles of debt just to pay their workers, send their children to school and put food on their own table. These issues are affecting farmers globally as Feedback's investigations in Latin America and the UK have shown.

The prevalence of UTPs in the food supply chain was first highlighted by the UK Competition Commission's investigation into the UK grocery market in 2000. It concluded that supermarkets engaged in inequitable business tactics, transferring financial risk onto their suppliers. Despite a voluntary code being established in response to this investigation, UTPs were continued to be experienced by suppliers of the UK's major supermarkets. In 2008 the Competition Commission responded to the persistence of UTPs by calling for a stronger code to be developed and the establishment of a supermarket ombudsman, The Groceries Code Adjudicator (GCA), to effectively tackle UTPs[35].

The GCA was established in 2013 and has the power to receive anonymous complaints from direct suppliers to UK retailers relating to UTPs; investigate breaches of the Groceries Supply Code of Practice (GSCOP); name and shame offenders; and crucially to fine supermarkets up to one percent of their turnover for breaches of the code. However, indirect suppliers, including British farmers, are unable to access the protection offered by this office and so continue to suffer the adverse effects of UTPS on their businesses.

Echoing previous warnings that UTPs continue to be practiced by retailers, Feedback's investigations demonstrate how British businesses continue to cancel orders on their suppliers and change forecasts at the last minute despite the existence of the GCA. UTPs drive overproduction and cause large amounts of food waste, contributing to the unnecessary loss of natural resources including water, land, and fuel. Addressing UTPs is the single most effective way of reducing food waste and overproduction in the supply chain, thereby creating greater resource efficiency in the supply chains of the UK's grocery sector.

Feedback is calling on the UK government and Competition and Markets Authority to extend the remit of the GCA to include regulation over the relationship between retailers and their indirect suppliers and to support legislation at the EU level to ensure that similar enforcement bodies are established across the member states to ensure coordination across the single market.

34 Feedback (2015) Food Waste In Kenya: uncovering food waste in the horticultural export supply chain. Available at: http://www.feedbackglobal.org

35 Competition Commission (2008) The Supply of Groceries in the UK: Market Investigation.

# CASE STUDY: THE UTILITIES SECTOR

## PHILIPPA ROBERTS, HEAD OF CIRCULAR ECONOMY & CARMEN SNOWDON, PRINCIPAL CONSULTANT, ASSET MANAGEMENT WRc

The emphasis of the EU's Circular Economy Package appears at first glance to be on the production, consumption and end-of-life management of consumer goods. The initial impression is that it is only businesses who deal directly with the household consumer who are relevant in the circular economy, when in fact there is a great deal of economic activity taking place outside the conspicuous retail arena. Most of it will be going on unseen and possibly unrecognised.

The topic of resource efficiency in supply chains, and the need to introduce sustainability initiatives across the supply chain, is relevant not just to what we consider consumer goods, but also to what we deem to be consumer services.

The potential for growth through innovation in the supply chain of the big utility sectors (water, gas and waste and resources) is sometimes overlooked. Data for 2012-13 showed that the total economic impact of the UK water sector was estimated to be £15bn and that the industry was employing over 166,000 people. In that year alone, £5bn was spent on operating expenditure, suggesting a supply chain with impact. More recent figures show that the turnover of the water and wastewater companies was approximately £11.4bn in 2014-15 in England alone.

The gas sector, both upstream and downstream, employs around 140,000 people. Our water and gas companies have existing assets worth billions of pounds that are renewed, restructured, shut down and redeveloped each and every year. The same is true for the waste sector, which is arguably the most engaged in the circular economy agenda, being at the sharp end of resource and material flows. Recycling, reprocessing and energy generation facilities are being developed by the waste and resource management sector every year and the industry employs around 140,000 people.

> The economic impact of our utilities sector is apparent. The role the sectors can play in generating and providing renewable energy, secondary raw materials, or water for reuse is clear. However, the role of the supply chain in these industries is explored less well.

Part of the issue is that the supply chains are probably considered simple and well defined. When you build large, expensive and complex capital infrastructure that will be in place for the next 25 to 65 years, there is a limited appetite to considering what will happen when it comes to the end of its life, as the end is so far away. When the discussion is about buildings the options are more straight-forward: more sustainable selection of materials; different ways of heating and lighting; different ways of using the space over time, including sharing space or rethinking the internal space; design for disassembly for the building as a whole at the end of its life. For facilities such as a gas distribution network, a wastewater treatment plant or an energy-from-waste plant, the options seem more limited. However, the issues are the same and the circular economy is just as relevant.

The design of these facilities with sustainability in mind is key and not just in terms of the services that they offer, but in the way that they are run and will be decommissioned. This in turn allows for maintenance and operating procedures that can be efficient and cause the least impact. This is

important when you consider that for water and gas much of the infrastructure lies beneath our feet. Then is a concern for how these facilities, and the land they are on, can be used most effectively. The sites and networks owned in the water, gas and waste sectors are in every county and are often considerable in size. Therefore the question must also be, can there be a better use of space and equipment in the form of sharing and co-locating and possibly reusing depreciated assets?

The answers to many of these questions may lie in the existing supply chains. These supply chains can be complex and varied. It is easy to think of small teams digging up roads or emptying bins and to ask how relevant the circular economy can be to such practices, however what of the process engineers, the chemical suppliers, the bin manufacturers, the vehicle sales companies and IT equipment support teams?

> The key to a better functioning, more cost-effective and circular supply chain, one that is more of a supply circle than a supply chain, is the quality of the information shared between each of the parties.

In a system that has traditionally been coy about information sharing because of concerns about commercial advantage, and regulatory comparison, this is perhaps, amongst the biggest steps. The key purchaser needs to know, and have fast, clear data about, each of the parts of its supply chain. The digital revolution that has taken place over the last few decades is the key to this, as it can only be possible to track this level of information in real-time with the benefits of fast, efficient modern technologies.

For example, water companies are required to consider the most cost effective options for balancing supply and demand in their areas. Whilst options might include the development of new resources such as reservoirs, activities that reduce demand are considered favourably for environmental and economic reasons. This could include the use of metering to reduce customer demand, or water efficiency measures such as different showerheads, cistern displacement devices and hose trigger guns. In some trial areas companies have also worked with developers to support the integration of alternative non-potable water supplies, and rainwater harvesting systems. Furthermore, companies are seeking to engage with customers in innovative ways, employing gamification techniques, to make water use behaviour change fun and sustained.

Smart metering is a higher profile area that allows information to be fed back to customers so that informed decisions regarding consumption can be made. The rich data on energy or water use in turn supports the utilities or 3rd party providers in building a relationship with, and making relevant suggestions to, customers, including neighbour-based comparisons, which are more likely to resonate with the customers and result in change.

These activities offset the need for capital investment, reducing resource consumption (both of the natural resource, and those that would be needed for the capital development) and at the same time build the relationship between the utility and their customers. Working on customer demand, with new developments to build efficient homes, and managing surface water through sustainable drainage options allows water infrastructure to be sized efficiently, reducing the resources needed, the environmental impact and the level of potential future investment required in asset maintenance.

Communication and collaborative working are also important. WRc works with the water, gas and waste industries and wants to support the development of new types of relationships within the supply chain of these sectors, and across the supply chains of different sectors. We believe that there are greater efficiencies to be gained from working across sectors, rather than just within them. Open relationships will allow for better feedback loops, which give procurers the right information to make better decisions. Open discussions may also result in better solutions, when what is being procured is no longer a specified solution, but an outcome. This may require companies to change to a leasing model or to procure services rather than products.

For example, the gas distribution network is currently being renewed across the country. While much of this renewal means replacing old iron pipes with new polyethylene piping, an alternative does exist, cured in place pipe (CIPP) liners. This involves relining existing old iron pipes to extend their life. This is both cheaper, and uses fewer resources, than the alternative replacement programme. WRc is currently helping the gas network owners understand the potential for asset life extension and the predicted longevity of these rejuvenated assets. If the procurer had just asked suppliers to tender to replace the pipes, there would have been no incentive to innovate.

The future of the gas distribution networks is highly debated and mixed up in a much wider energy futures debate around how we will heat our homes, cook our food and travel in the future. Coupled with this, natural gas is a finite resource, and we need to identify appropriate low carbon ways to meet our energy demands in the future. The gas sector has been exploring the potential viability of using the existing gas distribution network to transport hydrogen, which could power boilers in homes and be delivered in the same way that natural gas (methane) currently is. This work could provide a use for the capital investment in gas distribution assets well into the future, beyond the time at which natural gas resources may be depleted.

In both these examples the sustainability of the business model is important. While R&D activities may attract subsidies and funding, it is important that the final solution is one that makes economic sense without this support. The argument for circular economy activities may not be environmental; they are just as likely to come because of their impact in driving down operating costs and extending asset life. In fact, as has been demonstrated in the examples above, these activities are happening already, but may not be recognized as circular economy initiatives, which demonstrates the importance of having a strategic overview.

These examples also show the importance of looking at our assets differently and the role of smart procurement: which leads into the next observation. It is relatively straightforward to investigate the materials and products used in any organisation, and to then look for alternatives, to decrease waste and to increase recycling.

However, we are interested in the spaces between the products and processes as well. This means design, planning, procurement, logistics, communications, big data architecture and analysis, real-time equipment and network tracking, asset mapping and above all, a clear vision for what a future in the circular economy looks like.

It is only when a systems approach is taken to the supply chain that a rigorous route map to a circular economy can be developed. This is perhaps more important in the utilities sector than in fast moving consumer goods. The timescales are so much longer that a vision and strategy need to be developed now, one that engages all parts of the supply chain, to ensure that the vision for a circular economy can be met in 15 or 20 years time.

**It is only when a systems approach is taken to the supply chain that a rigorous route map to a circular economy can be developed.**

# CHAPTER 3: DESIGN AND MANUFACTURE

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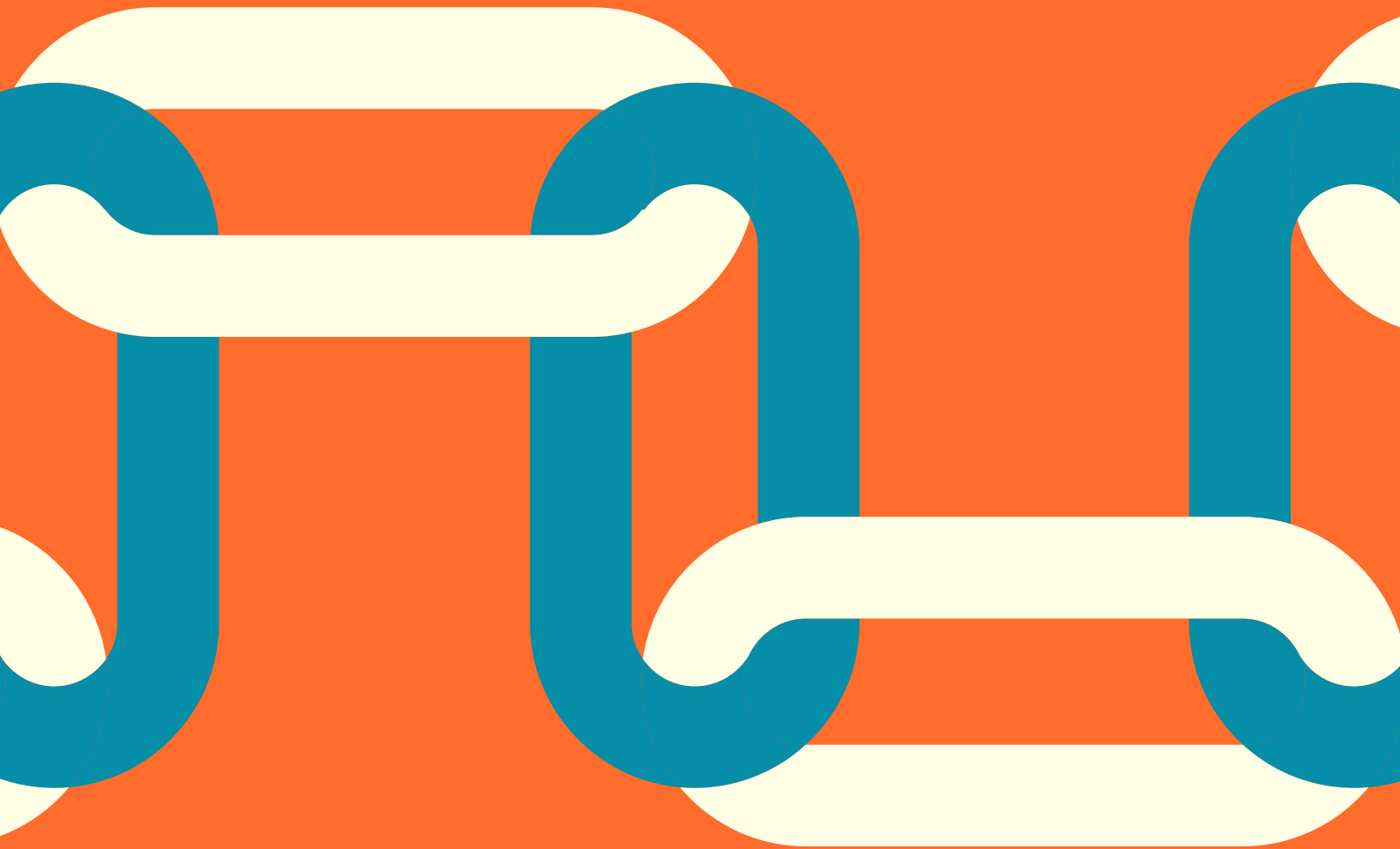

## Sustainable design

Studies have shown that about 80% of the environmental burden and cost of a product is fixed during the design phase[36]. 'Sustainable design' or 'Design for Sustainability' (D4S) therefore presents a huge potential for organisations to target their environmental problems and make positive contributions to reduce waste production both at an early stage of a product life cycle as well as at consumer and post-consumer stages.

Many organisations have developed tools and approaches to help companies rethink how to effectively design and produce products and services to improve profits and competitiveness whilst also reducing environmental impacts at the same time[37]. For example, in the past few years, PUMA has introduced several tools and initiatives that aimed at introducing sustainable design principles into its products (see case study at the end of this chapter).

> The concept of sustainable design entails the integration of not only product but also process design with material selection systems, development of models and approaches for assessing the integration of customer demand and product use, disposal or recycling, improvement in methods, tools and procedures for evaluation of the risks associated with environmental hazards.

Advancement in technologies and techniques certainly can help the development of new materials and the improvement of manufacturing processes. However, sustainable design and innovation is not necessarily about new technologies, but about rethinking how to meet the need for growth while at the same time reducing negative environmental impacts such as increased raw material consumption[38].

Sustainable design and innovation is not necessarily about new technologies, but about rethinking how to meet the need for growth while at the same time reducing negative environmental impacts.

## Sustainable design practices

Table 1 presents some common sustainable design practices currently adopted by industries. Amongst these practices, priorities should be given to those that fit specific organisational circumstances (e.g. technological and innovation capabilities) and industrial characteristics. In addition, considering the current industrial development and economic environment, government and policy makers should promote and encourage businesses to design for resources conservation, waste minimisation, resource recovery/reuse and re-manufacturing. These practices are most economically viable and cost effective and most importantly, they can create a huge impact on the environment if widely adopted, both at the macro-and at the micro-level. government and policy makers may consider introducing a sustainable score rating system for businesses and give credit for those firms who are more proactive towards sustainable design. These firms may receive certain tax rebates or lower business rates for being greener. Government should also promote collaborative research in sustainable design bringing expertise from both academia and industry. A set of guidelines and sustainable score indexes should be developed to facilitate the adoption and accreditation of sustainable design by organisations.

36 Rebitzer, G. (2002) Integrating life cycle costing and life cycle assessment for managing costs and environmental impacts in supply chains. Cost management in supply chains, pp.128–146.
37 UNEP et al. (2006) Design for sustainability: A practical approach for developing economies.
38 Clark et al. (2009) Design for sustainability: current trends in sustainable product design and development. Sustainability, Vol.1 p. 409-424.

Table 1: Sustainable design practices

| Sustainable Design Practices | Examples |
|---|---|
| Design for Energy Conservation | Reduce energy use in production and distribution (e.g. transportation distance), reduce device power consumption, use renewable energy, etc. |
| Design for Resource Conservation | Design for product longevity, design for packaging recovery, design upgradable components, design for durability, design reusable platform, etc. |
| Design for Waste Minimisation | Design for source reduction, reduce product dimensions, specify lighter materials, reduce packaging weight, use paperless documentation, etc. |
| Design for Recovery/Reuse | Design for material recovery, specify recyclable materials, use recyclable packaging, design for component recovery, design for refurbishment, etc. |
| Design for Disassembly | Optimise disassembly sequence, design for ease of removal, simplify component interfaces, design for simplicity, reduce product complexity, etc. |
| Design for Remanufacturing | Reduce virgin material extraction rates, reduce waste generated from raw material separation and processing, divert residual materials from waste, etc. |
| Design for Risk Reduction | Avoid toxic/hazardous substances, reduce production releases, avoid ozone-depleting chemicals, assure product biodegradability and waste disposability, etc. |

## Stages involved in sustainable design

Sustainable design is a complex undertaking. The process of integrating environmental considerations into a design cycle can vary from projects to projects and from firms to firms. In general, three basic steps are involved, including:

- Evaluating designs generated by engineers for environmental compatibility;
- Identifying barriers to hazard reduction, resource recovery (such as recycling) and energy conservation;
- Translating barriers into recommended design changes and communicate back to the engineers.

## Challenges of sustainable design

Sustainable design implies a great potential for reducing the lifetime environmental impact of products. However, before companies can make significant progress in implementing effective sustainable design initiatives, many issues remain to be resolved and challenges met. Some of the major barriers include:

- Lack of supplier capabilities;
- Availability of guidelines and checklists;
- Lack of practical environmental impact assessment methods;
- Scarcity of environmentally sound material and process choices;
- Lack of internal resources and technological cabilities;
- Dependence on external factors.

## Collaboration is the key to success

> Sustainable design is typically a multidisciplinary and multi-levelled project, which requires the focal firm to possess specific organisational resources and capabilities to successfully implement specific sustainable design practices.

Sustainable designers need to develop standards and guidelines in assessing different alternatives and in evaluating various trade-offs which can be quickly applied. The commonly accepted standards and guidelines may be more beneficial within a particular industry albeit this is difficult to achieve. In addition to the existing eco-design framework and guidelines (e.g. EU Directive (2009/125/EC[39]) that has a particular emphasis on energy-related products), the British Standards Institution (BSI) is recommended to develop an overall, more integrated sustainability index/ standards databases focusing on the whole supply chain, addressing all the aspect of production of a product.

External factors must be taken into account as sustainable design often involves interaction among various parties in the supply network such as suppliers, logistics providers and customers. Strong collaboration and coordination among these network partners is the key to success. Taking design for recycling for example, it necessitates the close coordination not only within the firm, between the designers and other functional units, but also with suppliers, recyclers and consumers in order to successfully incorporate recycling considerations into product design (see Fig 1 below).

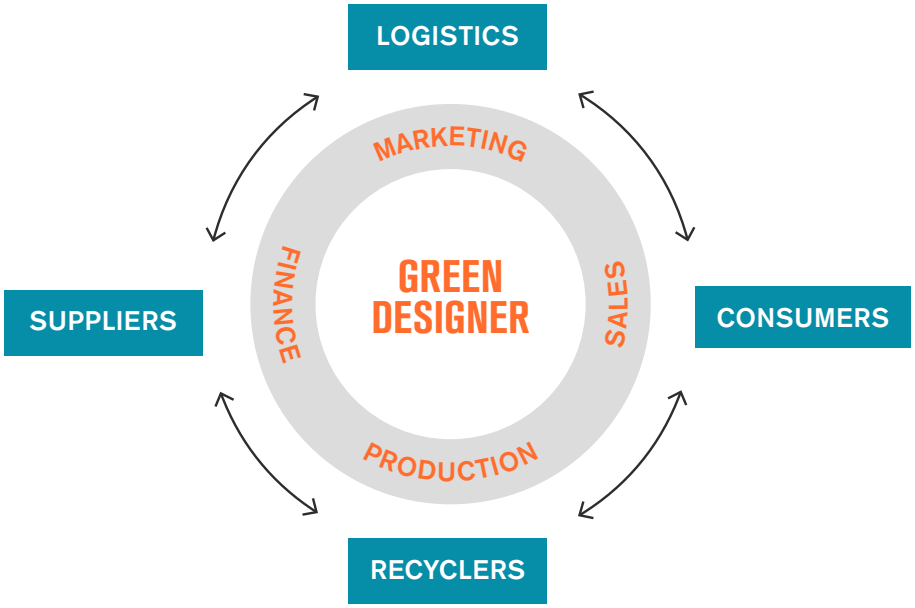


Figure 1: Collaboration Mechanism for Sustainable Design

Again, by introducing the sustainable scoring system, Government may facilitate the joint-effort in R&D and collaboration among the various partners along the supply chain for creating and designing more sustainable products. Similar to the Carbon Trading Scheme, it is suggested that the sustainable/green score of businesses can be traded by exchanging their resources, collaborative recycling as well as waste and by-products trading.

39 BSI (2015) Eco-Design. Available at: http://shop.bsigroup.com/Browse-by-Sector/Design/Eco-design/

## Sustainable manufacturing

In a supply chain, up to 50% of the total emission of greenhouse gases come from production and thus sustainable manufacturing is vital in moving towards more environmentally sustainable supply chains[40]. The main goal of environmentally conscious manufacturing (ECM) is to reduce the environmental impact of the manufacturing process, both in terms of energy and resource efficiency, at every stage. ECM has three fundamental objectives:

- Decrease emissions, hazards, effluents, and accidents;
- Minimise the life cycle cost of products or services;
- Reduce the use of virgin materials and non-renewable forms of energy.

ECM initiatives include not only production process optimisation but also cost and waste reduction through life cycle costing, life cycle engineering and process design. Hence, process reengineering, technology upgrades and process design are critical to sustainable manufacturing. In addition, ECM requires effective inventory management, production planning and scheduling in addition to usual planning because of varying and unexpected amounts of returned products from recycling[41].

When designing sustainable manufacturing systems, several considerations must be taken into account, including how products can be reused, recycled, refurbished or remanufactured at the end of their lives and how the accumulation of waste and byproducts can be minimised both in the manufacturing process and once the product has been sold to the consumer or retailer.

## Benefits of sustainable manufacturing

Government and policy makers have imposed tough regulations on organisations' environmental performance, impacting their bottom line. For instance, the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations implement Directive 2002/95/EC and restrict the use of certain hazardous materials (lead, cadmium, mercury, etc.) in the manufacture of various types of electronic and electrical equipment[42]. Recent research has indicated that sustainable manufacturing can not only offset the cost of regulations, but can also bestow a series of tangible and intangible benefits[43].

A large and growing number of manufacturers are realising substantial financial and environmental benefits from sustainable manufacturing. ECM also enhances employee, community, and product safety[44].

40 Emmett, S and Sood, V. (2010) Green Supply Chains: An Action Manifesto. Oxford: Wiley.
41 Nikbakhsh, E. (2009) 'Green supply chain management', Supply Chain and Logistics in National, International and Governmental Environment, pp. 195–220.
42 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2008. Available at: http://www.legislation.gov.uk/uksi/2008/37/contents/made
43 Emmett, S and Sood, V. (2010) Green supply chains: An action manifesto. Oxford: Wiley.
44 U.S. Environmental Protection Agency (2015) Sustainable Manufacturing. Available at: http://www.epa.gov/sustainablemanufacturing/

## Remanufacturing

Remanufacturing has recently become another hot topic in sustainable manufacturing especially in its interface with the waste and resource industry. Unlike reuse, recycle, refurbishment, remanufacturing is "a series of manufacturing steps acting on an end-of-life part or product in order to return it to like-new or better performance, with warranty to match"[45]. As noted by APSRG reports and in Chapter 3 of this collection, remanufacturing presents a huge financial and environmental opportunity for the UK.

For firms wanting to adopt remanufacturing alongside its existing manufacturing systems effective forecasting, production planning and scheduling, capacity planning, and inventory management must be presented because of the increased uncertainty and complexity involved. Strong collaboration and accurate communication with recyclers, logistics providers, original equipment manufacturers, third party remanufacturers and customers are also required for timely and smooth coordination. Table 2 reveals the 7 major complicating factors for effective production planning and control in remanufacturing.

Table 2: Factors complicate planning and control in remanufacturing

| Complicating factors | Forecasting | Logistics | Scheduling/ shop floor control | Inventory control and management |
|---|---|---|---|---|
| The uncertain timing and quality of returns | ○ | ○ | ○ | ○ |
| The need to balance returns with demands | | | | ○ |
| The disassembly of returned products | | | ○ | ○ |
| The uncertainty in materials recovered from returned items | | | ○ | ○ |
| The requirement for a reverse logistics network | | ○ | | ○ |
| The complication of materials matching restriction | | | ○ | |
| The problems of stochastic routings for materials and highly variable processing times | | | ○ | |

45 APSRG (2014) Remanufacturing: Towards a Resource Efficient Economy.

## Lean and Green

Lean production, which is commonly referred to as 'Lean', is a competitive practice that helps organisations to cut waste, reduce costs, improve environment and quality and the bottom line (Fig. 2). Lean production aims to eliminate waste and non-value-adding operations in every corner of production. A recent study[46] has highlighted that lean practices deployed at manufacturing level such as waste reduction, total quality management (TQM), and just-in-time (JIT) have a significant impact on the company triple bottom line (3BL) performance. The research project *Lean & Green Production Navigator*[47] has also highlighted the mutual benefits of combining Lean-based improvement programmes and Environmental Management Systems (EMS) in manufacturing

'Lean' has been highly effective in streamlining supply chains in a variety of industries, ranging from automobiles to chemicals, with the following being reported from a variety of manufacturing industries

| Increase of | Reduction of |
|---|---|
| 57% in productivity | 83% in lead times |
| 45% more capacity | 54% in set up times |
| | 67% in space requirements |
| | 38% in supply chain costs |

Figure 2: Effects of 'Lean' production on supply chain

In the automobile industry, the vastly adopted 'Just-in-Time' (one of the key paradigms within lean) operations has helped the industry significantly cut its waste in inventory by removing excessive stocks, smoothing the supply chain and shortening the lead time by removing non-value-adding activities, and increasing productivity through continuous improvement on the shop floor.

Government regulatory bodies and policy makers should adjust and further develop essential regulations and policies to promote the implementation of 'Lean and Green' manufacturing standards.

## Challenges of sustainable manufacturing

Manufacturers will have many challenges when adopting a sustainable manufacturing strategy. Some of the main challenges include:

- Lack of top support and commitment;
- Outdated technology;
- Perception of extra costs;
- Lack of cooperation with supply chain partners;

46 Govindan K., Azevedo S. G., Carvalho H., Cruz-Machado V. (2014) Impact of supply chain management practices on sustainability. Journal of Cleaner Production, 85, 212-225.
47 Lean and Green Production Navigator (2011) Available at: http://www.ipr.mdh.se/projects/289-Lean_and_Green_Production_Navigator

- Lack of clarity on green impact of different technologies;
- Outsourcing to non-transparent manufacturing locations;
- Lack of regulation and/or policy support.

To overcome these challenges, both intra- and inter-firm collaboration and coordination are required (see Table 3). It would necessitate seamless communication internally within the organisation and externally with all the supply chain partners. On a national level, government and policy makers should provide necessary support and incentives to promote sustainable manufacturing, both locally and globally, and especially for those SMEs. For example, by using the sustainability scoring system, highly rated companies can enjoy certain tax relief and possible lower business rates.

Table 3: Collaboration and coordination required to overcome sustainable manufacturing challenges

### Clear responsibility

Government: develop regulations and/or policies to facilitate the development of industrial common standards and guidelines. Introduce sustainability scoring system for measuring responsibilities of manufacturers
and businesses.

Manufacturer: conserve on resources, use material that is less toxic and readily refurbished or recycled; collaborate with suppliers on environmental capabilities development, set clear standards and responsibilities; offer incentives.

Retailers: source products from sustainable producers, encourage customers to return the goods after consumption for reuse, recycling, refurbishment or remanufacturing.

Suppliers: proactively engage in sustainable manufacturing, and meet environmental standards; willing to open and disclose sensitive data; share critical information and knowledge with customers and even with competitors.

Customers: choose environmentally safe products and recycle.

### Integrated and transparent cost

The cost of recycling, remanufacturing or disposal should be part of the total cost. i.e. recycling, remanufacturing as cost minimizer than cost driver.

Thus, manufacturers and consumers will have drive and incentive to reduce their cost.

### Top management support

Top management should support and promote the sustainable manufacturing initiatives that use less resources (energy and material) and produces less waste.

### Government support

Government should provide incentives for sustainable manufacturing e.g. lower business rates, tax relief, lower bank loan rates, etc. which are based on business sustainability credit score.

Provide information needed to make an informed decision on environmentally safe purchasing, usage, recycling/disposal decisions.

Develop sustainability scoring system for measuring business sustainable performance.

## Looking forward

The advancement of technologies, prevalence of smart devices, intelligent materials and 3D printing as well as big data, cloud computing and Internet of Things (IoT), have certainly created great opportunities for companies to come up with new designs, new processes, new materials and new systems to tackle their negative impacts on the environment and are opportunities which have been mentioned in several of this collection's contributions showcasing their relevance throughout many levels of supply chain systems (see Figure 3).

Novel technologies and innovative processes may bring breakthroughs to the existing operations in specific industries, therefore facilitating sustainable design and manufacturing. For example, new research has indicated that combining a mixture of long strands of shredded paper with a sodium silicate gluing agent could create a new composite which is as strong as MDF (medium density fibreboard). This material is also quick to manufacture and can be moulded into various shapes, which improves the management of water, production efficiency and increases the lifetime of paper products. This new composite could become an important future sustainable material for the manufacturing and construction industries[48].

In the big data era, companies are in a better position to understand their customer demands and capture the market tends. The fashion giant, Zara, for example, collects vast amounts of customer feedback and then uses big data to analyse best-selling rank, improve clothing design and styles. The information and data collected from stores are sent by branch managers through the global information network inside Zara to Zara headquarters. The designers then update the product and send the final draft to the different manufacturers. Zara makes decisions based on the data they have all in real time and this type of IT Infrastructure could also be used to cut inventories and waste within their production system[49].

A recent study conducted by Cambridge Service Alliance: *Future Technologies Facilitating Servitization in Manufacturing* suggests that digital technologies, rather than other novel technologies, such as self-healing materials or nanotechnologies, remain the major pioneers of change for firms, a point also made in Chapter 8 on business models.

48 Ianakiev A. (2014) How old paper can be transformed into a material strong enough to build walls, The Guardian, 17 July 2014. Available at: http://www.theguardian.com/sustainable-business/waste-paper-walls-home-sustainable-material

49 Medium (2014) Zara: A successful big data application. Available at: https://medium.com/@jiarongzhang/zara-a-successful-big-data-application-9ada5be0851d Digitalist (2013) Cloud Computing and Fashion Giant Zara. Available at: http://www.digitalistmag.com/cloud-computing/cloud-computing-and-fashion-giant-zara-029092

## 5 Major Trends

| | |
|---|---|
| 1 | New available materials will bring new opportunities (eg lighter, low impact materials) |
| 2 | Smart technologies and intelligence will enhance firms to make better informed decisions |
| 3 | Design optimised, more energy efficient distributuion networks |
| 4 | Smarter and greener buildings and factories |
| 5 | 3D printing brings great opportunities as it changes the way we design and make things |

**Figure 3: The 5 major trends in sustainable design and manufacturing[50]**

## Conclusion

In conclusion, sustainable design and manufacturing bring both opportunities and challenges for businesses to target their negative environmental impact. The innovative sustainable processes and practices could help industries to improve resource efficiency and waste minimisation, enhancing the TBL performance. Emerging and break-through technologies could boost the efforts in sustainable design and manufacturing such as the low-environmental impact materials and 3D printing technologies. Organisations should seek wider collaborations from across the whole supply chain, including suppliers, customers, recyclers, NGOs and various stakeholders in order to develop novel processes and technologies in this endeavour.

Government and policy makers should encourage the network-level collaborations and provide regulatory support to facilitate sustainable development in product design and manufacturing. Particularly at a macro level, government should provide infrastructures and incentives to industries to 'close the loop' and develop a circular economy. This encouragement could then feed into customers' and individual businesses' encouragement to recycle, reuse and take those unwanted and end-of-life products back to the loop.

50 Mapolitano, M. (2013) 7 trends in sustainable design. Available at: http://www.logisticsmgmt.com/view/7_trends_in_sustainable_design/sustainability

# CASE STUDY: PUMA

## DR KURT YANG LIU
## LECTURER IN OPERATIONS MANAGEMENT
## NORTHAMPTON BUSINESS SCHOOL

PUMA, one of the biggest sports equipment manufacturers, ships 80 million pairs of shoes per year to shops all over the world. Usually, shoes are packaged in an attractive, printed cardboard box. The box of shoes is typically placed in a heavy-duty plastic shopping bag. When it comes to reducing packaging waste and carbon emissions, plastic isn't the only material that companies are looking to cut. PUMA realised that it was possible to save substantial costs, reduce environmental impact and improve convenience for the customer if an easier alternative to the cardboard box could be found.

After 21 months of work and thousands of rejected ideas, PUMA introduced its 'Clever Little Bag' – a new initiative to reduce harmful waste associated with paper production, transportation and disposal.

The Clever Little Bag is made of non-woven fabric (recycled PET), which can be heat stitched rather than sewn. The bag is placed over a frame of simple corrugated cardboard that protects the shoes and creates a square form that makes it easy to store. The bag can be recycled and is also biodegradable.

The Clever Little Bag uses less packaging and reduces water, energy and fuel consumption by more than 60% a year. The package's paper material is reduced by 65%. With a light design, the Clever Little Bag uses less energy to transport. The sleeve that replaces the cardboard material is a nonwoven bag that creates less waste throughout its production. It also becomes a reusable bag after purchase, ideal for shopping and storage, and reduces the company's usage of single-use plastic carrier bags.

Source:
PUMA Annual and Sustainability Report (2011) Available at:
http://www.puma-annual-report.com/en/PUMAAnnualReport2011_ENG.pdf
Smarter Innovation (2015) Case: PUMA clever little bag. Available at:
http://www.smarterinnovation.org/The-method/Case-PUMA-clever-little-bag.aspx
Heritage Pioneer Corporate Group (2015) What is PUMA's Clever Little Bag? Available at:
http://www.hpcorporategroup.com/what-is-pumas-clever-little-bag.html

# CASE STUDY: BMW

## DR KURT YANG LIU
## LECTURER IN OPERATIONS MANAGEMENT
## NORTHAMPTON BUSINESS SCHOOL

The Dow Jones Sustainability Index is the most influential stock index for sustainability-driven companies worldwide. This award recognises that, since 2005, the BMW Group has been the world's most sustainable premium auto maker.

The BMW Group continuously increases its resource efficiency by integrating environmental management into all production processes. For the past 8 years, BMW has been able to achieve significant environmental impact reductions such as: waste for disposal (74%); CO2 emissions (37%); and energy consumption (34%).

In 2014, utilisation of resources and emissions per vehicle produced were reduced by an average of 6.7% compared with the previous year, yielding savings of €15.8 million. The BMW Group has established environmental management systems at 100% of its production plants and plans to install them at all future facilities.

The BMW Group engages in recycling management throughout material life cycles. Part of this entails continuously optimising their processes and reducing waste volume. The Group comply with the five-step hierarchical model set by the European Union and focus on the areas of action within its supply chain as set out in Table 1 below.

Table 1: BM's supply chain areas of action

| Area of action | Example |
|---|---|
| Complete utilisation cycles at plants | e.g. sheet metal scraps from press line are sent back to the same steelworks the coils for vehicle production; old plastics containers go through a recycling process that produces new containers |
| Applying best practices to avoid waste | e.g. changing the processing method for washing water on the vehicle production line for brake discs at Berlin plant, which leads to a reduction in waste for disposal of approx. 14% |
| Actively managing waste | e.g. manage and gather data on all waste and materials at BMW production plants worldwide using a central waste information system "Abfallinformationssystem" (ABIS) |
| Recycling of new materials | e.g. For waste from carbon-fibre-reinforced plastics (CFRP), use new recycling processes such as the manufacture of granulate as a filler material for thermoplastic applications (e.g. plastic components in vehicles). |

Source: BMW Group Sustainable Value Report (2014) Available at:
http://www.bmwgroup.com/com/en/_common/_pdf/BMW_Group_SVR2014_EN.pdf

# CHAPTER 4: LOGISTICS' ROLES AND CONTEXT IN THE CIRCULAR ECONOMY

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Director
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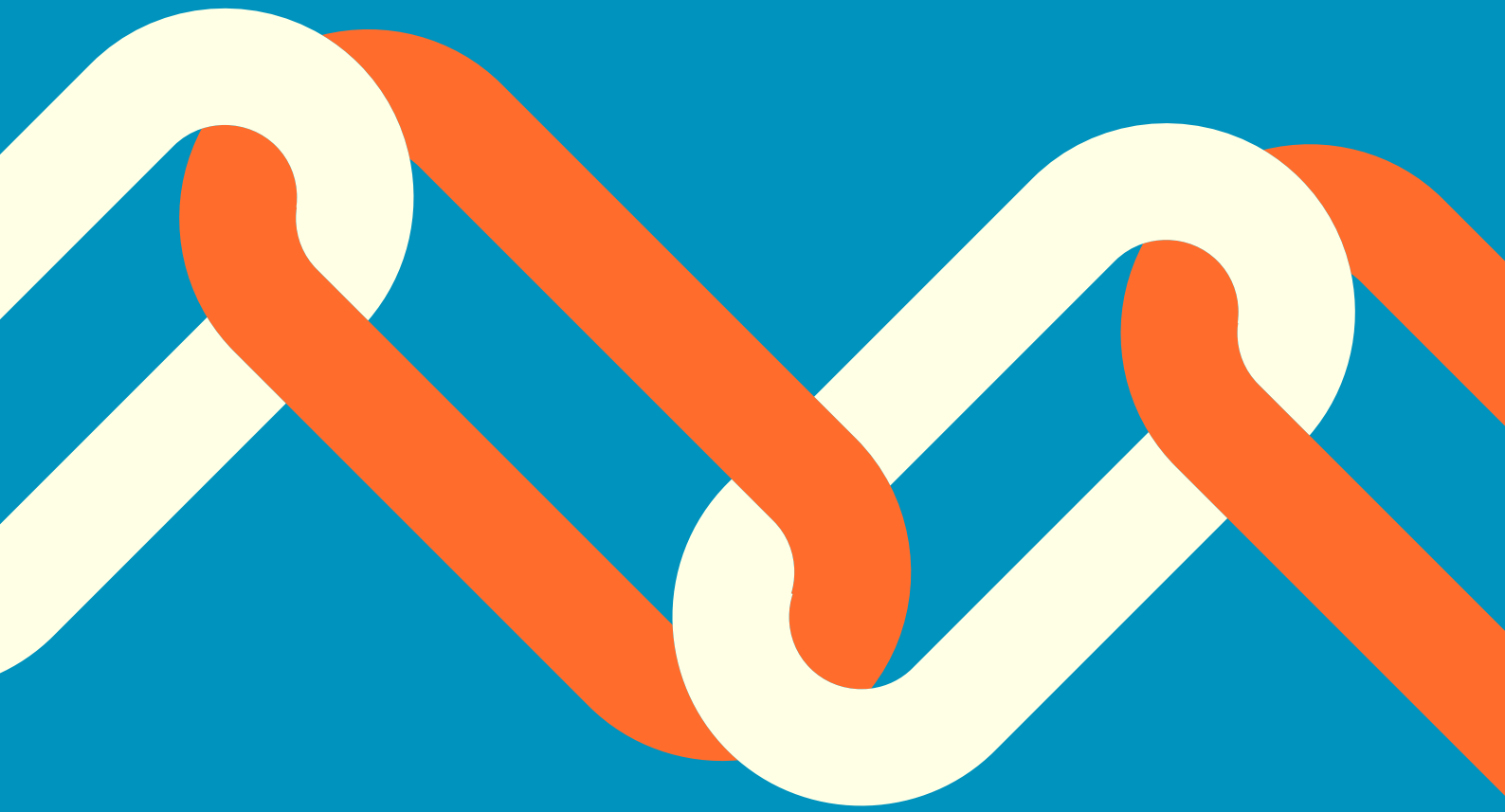


## Summary

'Logistics', the physical movement and stock management element, is a Cinderella area in the evolution of a cost efficient circular economy. This essay explores ideas for macro-economic as well as sectoral evaluation of the external drivers shaping and driving the introduction of cost effective and profitable alternatives to current linear approaches to material management at end-of-life, with a particular emphasis on movement and storage. Thereby it offers pointers to further policy and technology shifts capable of supporting improved levels of supply chain resource efficiency and raised added value. It also considers intellectual and operational barriers created within logistics to the delivery of the circular economy.

## The "Cinderella" factor in context

Total levels of physical retail material consumption in the UK are around 1 tonne per capita per annum split 50/50 between food and drink products and non-food and drink products[51] at the level of personal consumption. This figure excludes intermediate industrial and commercial uses, to make up 30 million tonnes of food/drink and 30 million tonnes of everything else. This can be termed as the 'in–bound' economy for all physical goods purchased at point of sale by private individuals, either for consumption (food) or as consumer capital goods (from cars to houses). The movement, warehousing and delivery of those consumer goods are handled on 390,000 goods vehicles over 3.5 tonnes[52]. Of the latter, 275,000 vehicles are 'rigid' fixed body trucks with up to 4 axles and the balance comprises articulated (generally) long distance trucks of up to 7 axles overall. This national fleet contributes 21% of the UK's total transport emissions of carbon dioxide[53] ($CO_2$) and just under 5% of total UK $CO_2$ emissions[54].

Within the 390,000 national rigid vehicle fleet there are 17,100 waste disposal trucks plus 5,400 'street cleansing' vehicles over 3.5 tonnes and up to 22 tonnes (7% of total rigids when combined). As is often the case, data is difficult to come by but Freight Transport Association reports[55] do comment on variations in the reported tonne/kilometres of heavy goods vehicle (HGV) traffic each year. In 2014, they reported a fall in total tonnage lifted in the UK down to a total of 1.5 billion tonnes. This is an interesting number which unfortunately does not identify the split between retail stage (final consumer), traffic, intermediate production and the tonnage of waste.

The latter comprises around 60 million tonnes of organic (active) waste and a similar amount of construction aggregates waste. Whether these form part of the total remains unclear. Against the 60 million tonnes consumed by UK citizens from all retail outlets this suggests a need for improved clarity on double handling within supply chains. This in turn would assist an improved overall understanding of where sector driven initiatives might best be initiated.

Additionally, this concentration on 'supply side' logistics to the economy is reflected in the Proceedings of the Chartered Institution for Logistics and Transport

51 BIFFA, The Mass Balance Movement ISBN 13 978-0-902484-95-5
Office of National Statistics: Data, Keynote Reports and Sector Studies.
52 Department for Transport. Collection: Vehicles statistics. Available at: http://www.gov.uk/government/collections/vehicles-statistics/
53 Accessed at: http://www.trucklocator.co.uk/
54 DAF "Road Transport & the Environment". Available at: http://www.daf.co.uk/
Department for Transport Environment Statistical Publications. Available at: https://www.gov.uk/
Road Haulage Association, Carbon Footprint Explained. Available at: http://www.rha.uk.net/
55 Freight Transport Association (2015) The Logistics Report 2015.

(CILT). A study of the Journal for that body over 50 years[56] will not reveal a single article dedicated to waste management logistics. Instead, research and debate are concentrated on passenger and freight aspects of inbound road, rail, air and shipping technologies. Recent authoritative publications[57] make no references to waste and end life resource logistics issues in their main conclusions or references to key catalysts. The concept of the Circular Economy is not mentioned anywhere in *Vision 2035* as a key catalyst and the environment is referred to mainly in the context of the need for fuel efficiency and exposure to forward threats relating to fuel supply costs.

This dichotomy is unfortunate given that over the last 45 years in-bound supply chains have overseen substantive changes driven by retail consolidation. This upheaval has given supply side logisticians unrivalled skills in reforming around 'hub and spoke' systems, just-in-time service delivery in stock control, information technology, data management, distribution 'parks', systems design and load modularisation (in terms of palletisation, roll cages, temperature control etc). These are the very skills and approaches which the old style, linear waste management logistics companies lacked in a 'collect and tip' framework which dominated up to 2009.

> Challenge 1: There should be an urgent reconciliation between Professional Bodies and others in the supply side and output post-consumer resource logistics sectors to broaden the understanding of lessons learned and opportunities available from the Circular Economy agenda. Emphasis should be placed on the need for improved data on logistics tonnage flows, differentiating retail from intermediate processes around broad categories of products.

## Sectoral drivers

Other chapters of this essay collection explore specific commercial drivers of resource efficiency, as such, the logistics function as a 'servant' of other core supply chain priorities (around pricing, design, quantity and similar issues) has to be reactive to those priorities. On the inbound side, the share of logistics costs is not insignificant[58], with logistics accounting for 30% of costs in food, 16% in electrical appliances, paper, textiles and automotive products. Perceived key drivers of the circular economy on in-bound supply chains therefore often comprise:

- Legislation and threats of Extended Producer Responsibility Directives (e.g. fridges);
- Scarcity costs of raw materials and virgin ingredients (for rare earth metals users);
- End user exposure to high linear waste disposal cost (especially agrochemicals and pharmaceuticals);
- Reputational risks (seen in the tyres industry);
- Alternative Customer demand (e.g. timber and wood products);
- Exposure to criminal activity;
- Recovery costs lower than virgin inputs (e.g. in packaging industry);
- Innovation of reprocessing technology (seen particularly in the paints and coatings industry at the moment).

56 The author has been a Member/Fellow for almost that time.
57 The Chartered Institute of Logistics and Transport (2011) Vision 2035: Transport, Logistics and the Economy.
58 Independent Transport Commission (2014) Improving efficiency of freight movement: the contribution to UK Growth.

These drivers need to be understood by the logistics phase insofar as they are more complex than the more simple parameters of stock rotation, consignment tracking, 'shrinkage' and timing pressures featured high on buyer's requirements for inbound consumption. The reverse logistics element of the circular flow is less constrained (relatively) by time deadlines, quality, cleanliness or theft for the bulk of materials.

More important is the trade-off between axes on a matrix of tonnage against value of goods on a product by product basis. Thus, low weight products with a high reclaim value (or attractive yield rate compared to virgin inputs) are the first to disappear from the linear (dump) route. Examples include electronics such as mobile phones, jewellery, broken pens, watches and similar domestic paraphernalia. Royal Mail has already moved into this space using brand strength to establish fair valuations transparency in an effort to expand parcels traffic. For a more in depth review see various Select Committee responses to calls for evidence[59].

In the linear (produce-use-dispose) economy, the waste industry emerged as a significant force in the late 1970's and expanded substantially in the following 30 years, reaching a peak around 2010. This emergence was the product of two unrelated but simple factors; the implementation of Clean Air Acts (which stopped the burning in fireplaces and out in the open), and, especially, the retail consolidation in food which exploded the volume and tonnage of intermediate packaging. Today this symbiosis between inbound supply chain costs and the potential impact of 'internalising' the costs of end life material recovery need to be re-visited and explored.

> Challenge 2: Product-focussed sector supply chains should be encouraged to produce holistic reviews internalising end life logistics costs into their existing total value added cost profile. This will enable them to identify measures which best optimise a shift to whole life product accounting. This is probably best undertaken by sector trade bodies, but strong measures may be necessary to ensure transparency and absence of restraint of trade issues in relation to competition and pricing. Data management systems developed for in-bound deliveries to retail need to be married to 'reverse logistics'equivalents to improve sectoral economic and resource efficiency.

## Points of intervention: waste arisings

In the 'end life'-phase, the logistics challenge is to balance the economics of selecting different types of points of collection of the targeted material or product to deliver (in the jargon) route density. This maximises the tonnage/kilometre profile for the selected vehicle type and thereby delivers the lowest unit cost of retrieval. This is also a balance between the pattern of material arisings and the final destination of the material into the next life cycle, be that as remanufactured products, recyclate, and energy or soil conditioner. For waste, the critical intervention points are thus at the point of production, at area consolidation points (Material Recovery Facilities or MRFs) or at specialist re-use locations for further refining and final processing (such as paper mills or renewable energy plants).

59 Environment, Food and Rural Affairs Committee: HC128 Session 2003-4. Available at: http://www.parliament.uk/

Such decisions can and, in the future, will be more often, driven by capacity, hygiene and space considerations available in the in-bound supply chain. In 2003, suggestions that baled card board, food and shrink-wrap available at retail outlets could be returned to Regional Distribution Centres (RDCs) was ridiculed[60], but today such practice is the norm. As a result hundreds of rolonof vehicles servicing retail compactors in the conventional waste sector have been rendered redundant[61]. Worse still, conventional waste operators have been displaced by general hauliers delivering in bound products to supermarkets from RDCs with routing controlled by retail buyers or logistics companies offering integration of transport and warehousing.

On occasions, control of recovery may shift from waste contractor to commodity supplier. Examples in packaging (notably paper and card) abound whereby the mill supplier negotiates product rates for initial supply (to package own branded product) with sliding scale discounts based on reserved material or exclusive recovery rights at retail back-doors. Implementation of traded permit systems such as Packaging Producer Responsibility notes (PRNs) offers additional opportunities for manufacturers to integrate vertically into the Circular Economy for remanufacture and reuse.

The other significant external driver posing a threat to conventional linear waste logistics systems is the rise of online shopping from home, coupled to home or independently run web-based collection centres for clothing, food and non-food items. Current share by value in food is around 18% and this is projected to rise to 25% by 2016[62]. This would suggest that empty back-haul space on large artic delivery vehicles from retail RDCs to retail stores, which drove the removal of roll-on-offs, could be replicated as householders are offered loyalty points to divert "waste" from their domestic Municipal dustbin to vans delivering their groceries. Inefficiencies in space utilisation on the so- called 'white van' fleet has been cited in government and Freight Transport Association (FTA) Reports over the years[63]. Such attractions are, again, accelerated by reward schemes[64], the PRN schemes and demands for higher levels of cleanliness and quality on recovered product (particularly packaging).

For commercial landlords of retail parks, industrial estates and factories, examples are manifold, especially where they incorporate material recovery as landlord responsibility in the lease and drive economies of scale via service contracts.

For those products subject to segregated regulatory requirements or which are bulky (e.g. pharmaceuticals, tyres, coatings, televisions, mattresses, luminaires, carpets and furniture), municipal Civic Amenity (CA) sites can offer the optimum collection concentration point for a logistics operator. These are advantageous in cases where the domestic or commercial waste producer undertakes the otherwise expensive low route density leg of the retrieval process. Additionally the Local Authority can be relieved of the cost of final disposal if product supply chains can deliver economies of scale coupled to economies of re-use or raw material substitution. Problematic materials from a Municipal perspective include mattresses, paints and coatings, and certain types of electrical equipment.

60 Author experience
61 ICE (2013) Water and Waste Paper 2013: Where have all the Roll-0n-offs Gone?
62 Independent Transport Commission (2014) Improving efficiency of freight movement: the contribution to UK Growth.
63 Freight Transport Association Activity Surveys. Available at: http://www.fta.co.uk/
Department of Transport Reports. Available at: http://www.gov.uk/
Independent Transport Commission(2014) Improving efficiency of freight movement: the contribution to UK Growth.
64 SUEZ (formerly known as SITA UK) trials and implementation in Berkshire, UK.

Finally the location of remanufacturing, reprocessing, recycling or energy conversion technologies on sites developed to convert recovered material is often specific to the weight/cube logistics costs specific to the product and the reuse application. Thus it may be cheaper to convey product rather than energy (as electricity) to an end application. Refining and remanufacture may best be undertaken on primary manufacturing sites where skills, safety requirements and other operational assets are already embedded[65].

> Challenge 3: Where supply chains agree to introduce sector specific initiatives, Local Authority Associations should consider the opportunities in a holistic, national context. This will encourage economies of scale and reduce costs of recovery to the benefit of making moving towards a more circular economy more cost effective compared to existing linear models. Sector product specific recovery logistics need to relate to an understanding of current space and route utilisation inefficiencies that may be improved by incorporating back loading of end of life products. The geographic selection of end-of-life site location should be balanced between density of material availability and density of material end use applications. Those end life alternatives (of remanufacture, recycling, energy conversion and/or soil conditioners) are subject to differing economic drivers and the logistics implications need to be integrated. Relevant cost implications need to be pre-established in terms of vehicle types, material storage and handling systems.

## An academic perspective

The University of Northampton is the holder of the waste industry technology archive transferred from Culham AEA some years ago. It has recently undertaken bibliometric analysis of 600 UK and other academic studies into the logistics of end life material management. This applied to peer and non-peer reviewed papers as well as specialist journal references. This was initiated to inform the County Council in regard to the locational drivers in which the East/South Midlands might demonstrate attractions to the emergent reverse logistics sector. It concluded that this was an emergent, fast moving area with significant job creation potential[66]. For inward supply logistics chains this is now self evident from the explosive growth of new warehousing in Lutterworth, Rugby, Daventry, Kettering and Northampton based around their geographic relationship to importation entrepots at Felixstowe, Southampton and Liverpool.

65 Anaerobic Digestion & Bioresources Association (ADBA) & House of Lords Scientific and Technology Group (2014) Waste or Resource? Stimulating a Bioeconomy. HL Paper 141 (2014) ISBN 978 10 855345 5.

66 Logistics Sector Analysis for Northants Enterprise Partnership 2014
Heutger,M. & Kuckelhaus,M. (2014) Logistics Trend Radar.

## Conclusion

> Perhaps this presents a further opportunity for research into the in-depth future drivers for locating waste reprocessing centres in the context of the Circular Economy? Patterns of logistics movements are likely to be moulded to 'down-stream' re-use and re-manufacturing sites, underpinned by the relativities of gate fees across different exit routes.

Forty-five years ago landfills were being developed around redundant aggregate extraction sites in the countryside as the least cost option. Thermal Energy plants appeared from thirty-five years ago in response to lack of void availability and soft loans to create additional 'hub and spoke' systems. Twenty years ago the Landfill Tax spawned innovations in recycling and other recovery options. Three years ago withdrawal of Public Finance Incentives and cheap oil heralded the entry of smaller scale reclamation and reprocessing sites. Thus far these have proliferated geographically independent of each other (often due to separate ownership) despite the logic of co-location between the material-energy fuel-soils-gas grid nexus. Logistics systems have coped, as they always will, transforming from small load feeders in bulk to local landfill, through large scale trunking in bulk to landfill and then energy to small scale disaggregated collection (recycling) alongside large scale bulking and palletised handling (from retail and MRF 'warehouses'). This rich tapestry will continue to evolve and delight.

# CASE STUDY: ARGOS

## PATRICK MAHON
## STRATEGIC ASSISTANT TO THE CEO
## WRAP

In 2013, UK high street retailer Argos was looking to develop convenient, sustainable options for customers to recycle electronic gadgets they no longer used, both to increase customer loyalty, footfall and spend, and to improve their environmental credentials. WRAP had developed relevant evidence, estimating that UK householders have in their homes around £1 billion worth of electrical and electronic equipment that is no longer used, while WRAP's consumer research showed that two-thirds of those surveyed said they would be willing to trade in their technology products with reputable retailers.

Working together under the auspices of the EU-funded REBus project[67] , Argos and WRAP developed a proposal for the 'customer journey' that a trade-in operation would require, the logistics system required to recover products back to a central point, and the requirements for a reprocessing partner to refurbish, data-wipe and trade the used products.

Once the project team established there was a strong business case, based around a convenient walk-in high street offer, it was essential to test the operation in a small number of stores to ensure the system worked smoothly. This involved setting up IT systems, logistics processes and staff training.

The 2014 trial proved that Argos could deliver a convenient offer to customers and provide them with real-time product valuation, with instant payment of the trade-in value to customers in the form of Argos vouchers if they decided to go ahead. In July 2015, Argos launched the service across all 788 of its UK stores[68].

Once an item has been traded-in, it is sent to an IT Asset Management (ITAM) company where the data is wiped. The item is then assessed to see if it can be refurbished for re-use. Refurbished items are resold by the ITAM in the UK and throughout Europe. Items that cannot be refurbished or repaired are broken down so that the parts can be recycled.

The project has initially focused on mobile phones and tablets. Depending on the response from customers, Argos may extend the scheme to include other electrical items in the future.

67 More information available at: www.rebus.eu.com .
68 WRAP (2015) Argos launches new gadget trade-in service at stores nationwide. Available at: http://www.wrap.org.uk/content/argos-launches-new-gadget-trade-service-stores-nationwide

# CASE STUDY: WASTE CONTAINERS TO RESOURCE CONTAINERS

## DR DAVID GILLETT MCIWM
## MANAGING DIRECTOR
## GJF FABRICATIONS LTD

Waste management used to be simple; the majority of waste was tipped at the customer site into large, heavy steel containers, possibly with a compactor embedded, and taken on a relatively short journey to be discharged into landfill. In our sustainable resource economy this process is becoming extinct.

> In the past, waste company revenue was dominated by fees for the collection of waste. Today revenue is dominated by the value achieved from the end point of the resource streams recovered from waste. This means there is a requirement for cost efficient collection, pre-treatment and transport of the waste / resources, as little value is derived until the end point.

Today's need is to collect waste containing mostly valuable resources, segregate the contents by material type (often to high purity), bulk them up, and route them to one of several value creating destinations. The choice of destination is now often a 'spot market' decision based on the quality of waste/resource streams and the value at that moment obtained from routing them to a multiplicity of potential end-points for example: a biomass plant; an incinerator; a plastics re-processor; a pyrolser adjacent to the materials recovery facility; or the export of refused derived fuel to a cement works in mainland Europe.

Throughout this process the cost and carbon footprint of the logistics and process chain must be minimised. This is revolutionising the size, ease of handling, functionality and tare weight requirements of the containers required to transport waste as resource streams.

> GJF Fabrications' investigations strongly indicate companies operating in the waste and recycling market will have to achieve world class logistics cost efficiencies by 2020 in order for them to compete effectively, putting great pressure on asset efficiency.

GJF Fabrications has seen this change coming and is investing heavily to revolutionise its offerings to meet the emerging needs, some from established waste and recycling companies, and some from entirely new breeds of entrants including companies in logistics, process technology, energy, and trade associations. Our investment has been in advanced modelling software, advanced product design and testing capabilities, and the exploration of novel materials for containers.

Examples include:

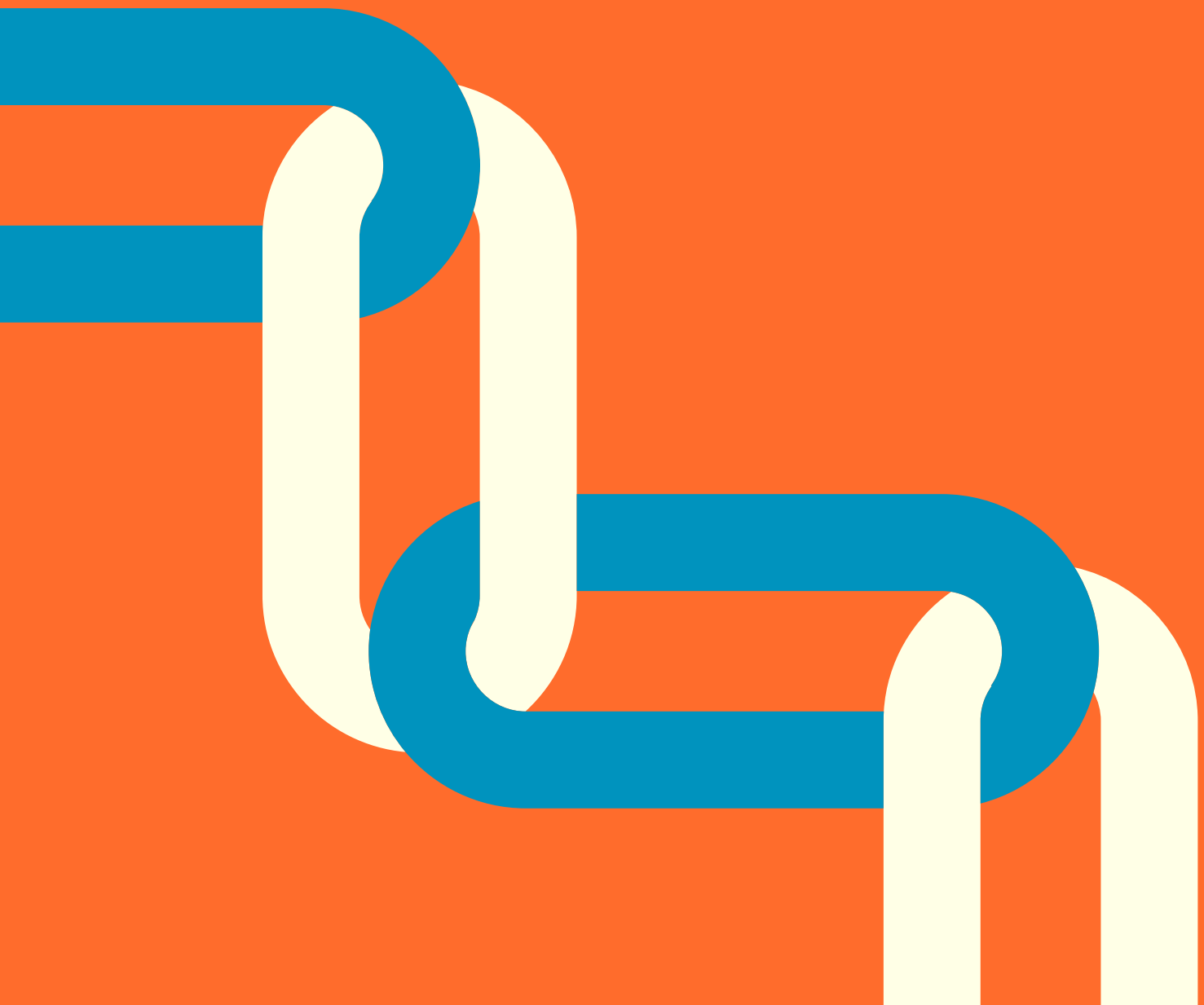
- Road, rail and marine containers for biomass and refuse derived fuels with built-in ventilation systems allowing the contents to be dried by injecting hot air into the container to achieve the optimum level of moisture for efficient combustion;
- Fabrication of containers from novel materials including composites with the aim of reducing container tare weight by over 70%, maximising the payload of the resource and minimising unit carbon footprint and fuel consumption;
- The design of container footprint, track and trace systems (including RFID and GPS) and counter-theft measures to provide the agile, auditable and secure handling and routing required by world class logistics operations;
- Fit for purpose designs that neither over nor under engineer the container to achieve the safe working load for the types of materials it is to contain, often bringing significant reductions in tare weight.

In closing, remember the concepts of 'just in time', tracking, and route optimisation, were unheard of for 'inbound' logistics in the 1970's but the winners applied that in the 1980's. Those lessons are now coming to the 'back-end' resource economy of the 2020's. GJF Fabrications can help you deliver[69].

69 GJF Fabrications' Thought Leadership Arm "GJF Thinking" looks at the emerging issues in waste & resources containment and logistics, and envisions how the containment market must work in partnership with the waste industry to address them. More information available at: http://www.gjffabrications.co.uk/

# CHAPTER 5: CONSUMERS AND BEHAVIOUR CHANGE

**Patrick Mahon**
Strategic Assistant to the CEO
WRAP



## Introduction

When considering the role of consumers in driving greater resource efficiency across supply chains, it is worth emphasising one point: businesses exist to serve consumers. Although contributions from all parts of the supply chain are vital to achieving resource efficiency, it is important not to forget that the primary purpose of business is to provide the customer with what they want. This creates an environmental opportunity. If customers start asking for more resource efficient products and services, this should drive changes across the entire supply chain. This is the reason why efforts to help consumers change their behaviour are so important.

The most effective way to drive resource efficiency at the consumer point in the supply chain is to address both supply and demand:

- Supply – businesses across the supply chain may need help when collaborating with each other to deliver more resource efficient products and services to their consumers;
- Demand – consumers may need information and tools to enable them to choose the more resource efficient option.

Doing the former without the latter risks creating new products and services that no-one wants to buy. Equally, focusing only on consumer choice risks raising expectations that cannot be met by the market. WRAP's approach to consumer behaviour change therefore focuses on tackling both of these aspects in parallel.

Following a brief introduction to WRAP and our work, the bulk of this essay consists of an explanation of how each of our consumer campaigns has led to change in consumer behaviour on the demand side, followed by a discussion of our use of voluntary agreements to drive change on the supply side. The complementary nature of these approaches is highlighted through a case study of our work on textiles, and the essay concludes with a brief look to the future.

## WRAP

The Waste and Resources Action Programme (WRAP) exists to help British business secure the resources it needs in the most efficient and sustainable way. This means finding new sources of raw materials like secondary materials recovered from waste and making better use of the raw materials we currently have access to.

WRAP's work has driven consumer behaviour change through three distinct mechanisms:

- Consumer behaviour change campaigns – specifically, the Recycle Now campaign (2004-present), Love Food Hate Waste campaign (2007-present) and the Love Your Clothes campaign (2014-present);
- Labelling – in particular, the On Pack Recycling Label;
- Supply chain voluntary agreements – for example the Courtauld Commitment (to reduce food and packaging waste), Hospitality and Food Service Agreement and the Sustainable Clothing Action Plan 2020 Commitment.

## Consumer campaigns

Each of WRAP's consumer campaigns has been developed on the basis of extensive evidence, to ensure that we understand the issue under consideration, the way that consumers respond to that issue and the best way to help consumers change their behaviour. A key point in each case is that the campaign does not solely raise public awareness of the issue, but also suggests specific actions and provides simple tools to help people to undertake these actions. This helps to overcome the well-known 'value-action gap'. We summarise the key features of the Recycle Now and Love Food Hate Waste campaigns below. Details of the Love Your Clothes campaign are contained in the textiles case study later on.

## Recycle Now

The Recycle Now campaign originated from a recommendation in the Prime Minister's Strategy Unit's 2002 report *Waste Not, Want Not*. The report stated that "WRAP should promote education and awareness of waste issues through a programme of national and targeted local or issue-specific campaigns related to waste minimisation and recycling."

This recommendation was based on a review of evidence which showed that waste awareness remained low in the UK despite previous national campaigns, and that good practice in other countries showed effective results from waste awareness programmes.

In response, WRAP worked with Defra, local councils and waste-focused NGOs to design a programme, combining national and local initiatives, that would overcome the weaknesses of previous national behaviour change programmes which had not had a significant impact on public action on waste issues.

> The Recycle Now programme was formally launched by WRAP in September 2004, with two linked targets: (a) to generate a minimum increase of 10% in the public perception of recycling as a 'must or should do' activity, following national campaign periods, based on a benchmarking survey; and (b) to achieve measurable and substantial increases in participation in recycling by householders in response to all local authority programmes using WRAP awareness campaign funding.

Progress against the first target was measured by reference to a 'committed recycler' metric[70]. At the launch of the Recycle Now programme, 45% of the English population were committed recyclers on this metric. This increased to 57% by the middle of 2006, exceeding the original 10% target, and it increased further to 74% by mid-2010. In addition, the proportion of people saying they do not recycle decreased from 14% to 2% over the same period. Similarly, there was significant progress on the second target, as evidenced by the substantial change in the municipal waste recycling rate, which increased from 19% in 2003/04 to 40% in 2009/10. On both measures, the programme was therefore a success.

70 The committed recycler metric measures the proportion of people who, when surveyed, agreed with all three of the following statements: recycling is very or fairly important to me; I recycle everything, or a lot, of what can be recycled; and I recycle even if it requires additional effort.

Following the 2010 General Election, and in the light of the coalition government's focus on reducing the deficit, the Recycle Now campaign reduced its activity significantly. However, it was relaunched in March 2014 and is now focused on addressing, in an evidence-based manner, the four key classes of barriers to recycling at home identified in WRAP research[71]: situational, behavioural, knowledge and attitudinal barriers. These barriers can be overcome by, for example, helping householders to get a collection service tailored (where practicable) to their property type and family circumstances.

The Recycle Now website has recently had additional functionality added, such as a Recycling Locator tool[72], enabling householders to find out easily where items can be recycled locally. Quarterly campaigns are also being run, each focused on a different material stream, with plastics being the focus of the first such campaign, run from September to November 2015.

## Love Food Hate Waste

Reducing food waste is important for both environmental and economic reasons as elaborated in Feedback's case study in this collection. WRAP has been working on this issue since 2007 when we launched the Love Food, Hate Waste (LFHW) behaviour change campaign.

To produce a comprehensive evidence base, we commissioned several research studies in 2006 and 2007. These identified the scale of the problem, investigated householders' knowledge, attitudes, beliefs and behaviour around food and food waste, and considered different ways in which householders might be supported in changing their behaviour. This reiterates comments also made in Chapter 8 and 10: it is vitally important to develop, collect and understand data, evidence and metrics when tackling waste and resource inefficiencies within supply chains.

There are a number of different approaches to reducing food waste. As well as working with consumers, the programme also works with the food and retail industry, since food packaging and technology can also play an important role. Improving or adapting packaging and applying technologies such as increasing the shelf life of products, using oxygen scavengers, modified atmospheres, interactive films and resealable packaging are all helpful in maintaining food quality for longer, both in store and at home, and so reducing food waste.

The behaviour change part of the LFHW programme was launched in November 2007 and consists of a national website[73], containing facts and figures along with ideas for how to reduce household food waste, supported by local authority programmes of local action.

As well as an active partnership with more than three hundred local authorities across the country, the LFHW programme works with the UK grocery sector, the food industry, the government and other organisations such as the Food Standards Agency to develop practical solutions and improved communications.

71 WRAP (2014) Barriers to recycling: a review of evidence since 2008, December 2014. Available at: http://www.wrap.org.uk/content/barriers-recycling-home%20
72 Recycle Now recycling locator available at: http://www.recyclenow.com/recycling-locator%20
73 More information available at: http://www.lovefoodhatewaste.com/

Between 2007 and 2012 avoidable household food waste reduced by 21%. This equates to 1.1 million tonnes of food, which would have cost £3.3 billion to buy. This prevented 4.4 million tonnes of greenhouse gases from being created, and saved a billion tonnes of water. In addition, in the first three years of the Love Food, Hate Waste campaign, the website was visited by over 1 million people, and over 2 million people made changes to the way they shop for, prepare, store and use food.

## On-Pack Recycling Label

The adequacy of recycling labels on product packaging has historically been a key issue for consumers. For example, when asked what could make people recycle more at the household, 'better recycling labels on pack' scored 7.6 out 10 in terms of relevance, showcasing just how important helpful communication can be in reducing waste at this stage of the supply chain.

One of the issues raised by consumers was that the traditional triangular recycling symbol on product packaging did not take account of the practical realities of the state of recycling in the UK. Some types of packaging (for example, plastic film) may be recyclable in theory, but were historically not recycled in practice in the UK. The On-Pack Recycling Label (OPRL) was developed jointly by WRAP and the British Retail Consortium to address this issue.

OPRL delivers a simple, consistent and UK-wide recycling message on both retailer and brand packaging, whether on groceries or DIY or health & beauty products, to help consumers recycle more material, more often. It was launched in 2009 and has grown rapidly, with over 150 manufacturers and producers, charities, retailers and leisure organisations currently using OPRL.

Recent research suggests that the OPRL is widely recognised by consumers, with 62% of consumers recognising the labels.

OPRL has been particularly helpful in communicating the greater levels of recycling of beverage cartons such as Tetrapaks, giving consumers greater confidence in their ability to recycle this increasingly common packaging material.[74]

## Voluntary agreements

As discussed earlier, much of what WRAP has achieved in driving greater resource efficiency in supply chains has come through the use of voluntary agreements. And although WRAP's voluntary agreements are negotiated with producers, they deliver clear benefits for consumers by helping signatories to develop more resource efficient products and services to put on the market, and by providing them with the evidence base that will help them communicate the benefits to their customers. This enables producers to respond to consumers whose behaviour has changed in the direction of demanding more resource efficient products and services.

74 OPRL: The On-Pack Recycling Label. More information available at: http://www.oprl.org.uk/

## Why use voluntary agreements?

Voluntary agreements are an alternative mechanism to legislation for achieving desired changes in behaviour by businesses. They have a number of potential advantages over legislation: they work with the grain of the market, can adapt to new circumstances quickly, have the potential to be better designed than legislation and encourage constant improvement and innovation.

## How should they be implemented?

Based on our experience, we feel that there are two key requirements for a voluntary agreement to be successful. It requires leadership from key organisations in the sector and it needs to be well designed and implemented. This means having a clear strategic direction underpinned by specific targets, and a consistent approach to measurement and reporting.

It is vital for the requirements of any voluntary agreement to be embedded in the subscribing organisations' business strategies to ensure delivery. Providing external support for delivery is also central to ensuring success, including support for innovation, tools and techniques to underpin the change, and regular meetings of the signatories to develop momentum.

## What makes for a successful voluntary agreement?

The key success factors for WRAP's voluntary agreements include consultation with the industry in developing the agreement, clarity in the agreement itself, an agreed framework and metrics for measurement and reporting, a robust business case to take to the industry and the provision of support to enable delivery.

# CASE STUDY: TEXTILES

WRAP aims to improve the resource efficiency of the clothing and textiles sector, working both with consumers and producers to reduce resource use, drive re-use and increase recycling.

## Consumers

The Love Your Clothes consumer campaign[75] aims to raise awareness of the value of clothes and to help consumers make the most of the clothes they already have. It encourages people to think about the way they purchase, use and dispose of their clothes.

As a nation we have a staggering £30 billion worth of clothes in our wardrobes which haven't been worn in the last year and we bin clothing which is still worth at least £140 million.

As discussed below, a key issue for Sustainable Clothing Action Plan (SCAP) signatories is designing clothes for a longer life. However, this will only deliver environmental and economic benefits if consumers actually keep these garments in use for longer. This is therefore an important focus for the campaign.

Love Your Clothes provides easy and practical tips and advice, through its website, social media channels, events and partner activities, on how to make your clothes last longer, reduce the environmental impact of laundering your clothes, deal with unwanted clothes and make the most of your wardrobe.

These actions will help to reduce the environmental impact of clothing by reducing the amount of carbon, water and waste created through manufacture, laundry and disposal whilst also helping to save money and resources.

## Producers

The Love Your Clothes consumer campaign was developed by WRAP with industry support as part of the SCAP voluntary agreement. SCAP brings together clothing retailers, brands, suppliers, local authority representatives, end of life organisations recyclers, charities, trade bodies, academics and the public sector to make change happen.

As at November 2015, over 80 organisations, representing over 50% of UK clothing retail sales, have signed up to the SCAP 2020 Commitment, under which they will aim to achieve a 15% reduction in their carbon and water footprints and the amount of waste they send to landfill, and a 3.5% reduction in waste arising over the whole product life-cycle.

A key focus for SCAP signatories is design for longevity: examining all phases of the life-cycle, from design through to manufacture and testing & trials process improvements, to deliver innovations that can increase the length of time before a particular garment type fails or is discarded. The potential benefits are significant: extending the active life of clothes by nine months would reduce their carbon, water and waste footprints by 20 to 30% each.

Examples of what SCAP partners are doing to engage their consumers include the John Lewis Partnership, who included messaging from Love Your Clothes in its Learning Guide, which is used to assist their Selling Partners to share durability messages with customers, and Clothes Aid, who have added 'proud to support Love Your Clothes' on their collections bags, helping to spread the message right across the UK.

75 More information available at: http://loveyourclothes.org.uk/

## Alternative approaches – New Business Models

Another approach to delivering resource efficiency through supply chains, which this essay does not have the space to go into detail about, is by returning to the first point we have made: the primary purpose of business is to provide the customer with what they want. Do consumers actually want washing machines, or clean clothes? Do they want DVDs, or access to new movies on demand? WRAP is working to develop innovative new business models that deliver resource efficiency by changing the way that the services consumers actually want are provided to them, in ways that extend the life of products, conserve resources and prevent materials from becoming waste[76].

## The future

Looking to the future, WRAP is developing Courtauld 2025, an ambitious ten year voluntary agreement that will bring together a broad range of organisations involved in the food system to make food and drink production and consumption more sustainable. This will follow on from phase three of the Courtauld Commitment and the Hospitality and Food Service Agreement, both of which came to an end in December 2015.

> Collaborative working across the supply chain, from producer to consumer, will be crucial to the success of Courtauld 2025. By working collectively the sector will provide lower impact products, provide them more efficiently, help consumers get more value from the food and drink they buy, and make best use of remaining waste and surplus food.

Consumer behaviour change campaigns will continue to be a vital part of WRAP's approach to driving resource efficiency through Courtauld 2025[77].

## Conclusion

Consumers are the reason why companies make products and services.

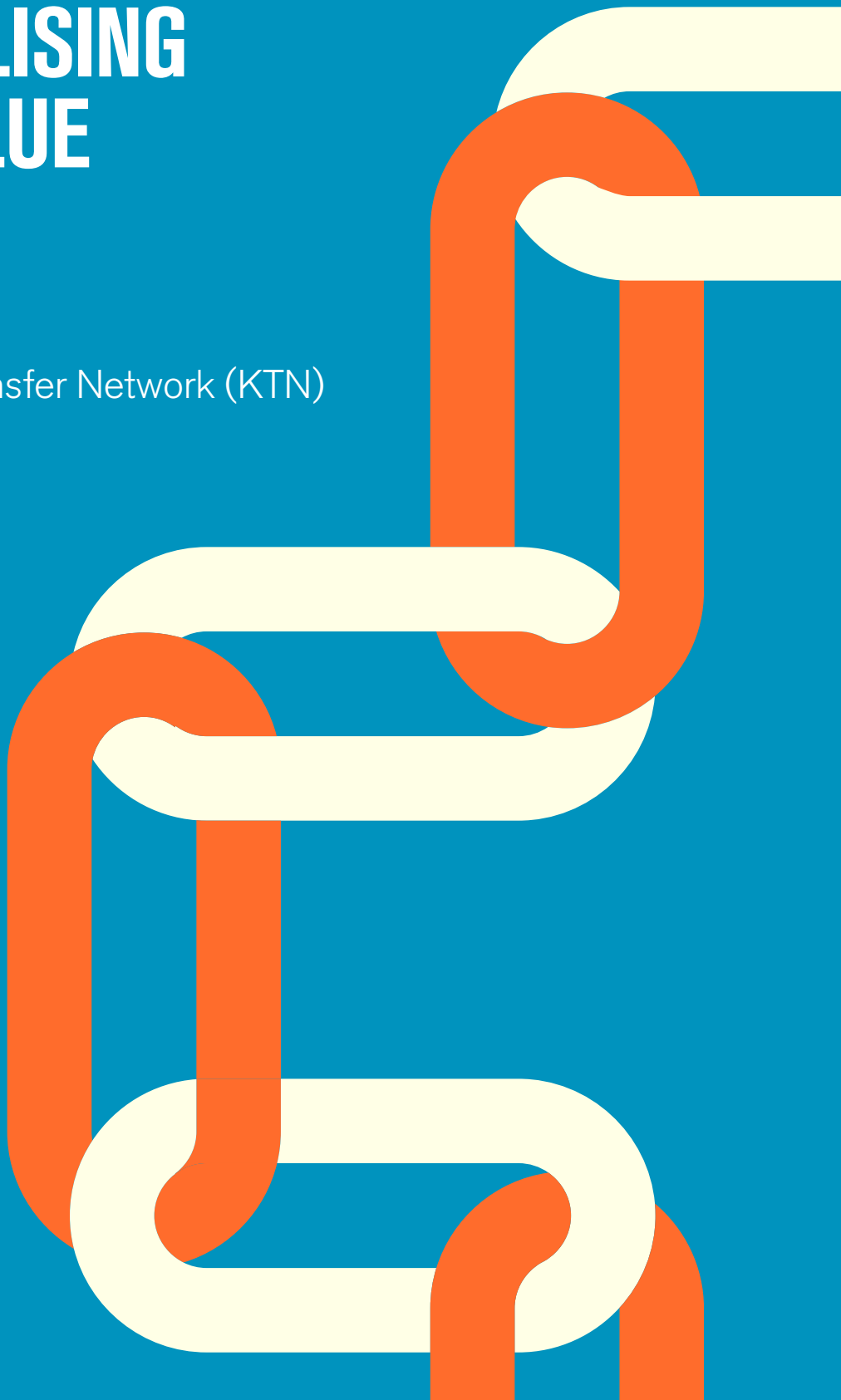
> And while most consumers would like the products and services they buy or rent to have a low environmental impact, it's not always easy for them to choose the greener option, or for producers to know how to deliver that option.

WRAP's consumer campaigns and voluntary agreements are helping companies in the retail, hospitality and clothing sectors to improve their resource efficiency and to offer greener products to their customers, and helping consumers to understand the economic and environmental benefits that these greener products and services offer them.

76 See more examples of innovative business models at: http://www.wrap.org.uk/content/innovative-business-models-0
77 More information about Courtauld Commitment 2025 available at: http://www.wrap.org.uk/courtauld2025

# CHAPTER 6: BUSINESS MODEL INNOVATION AND EPR: REALISING MORE VALUE

**Ben Peace**
Sustainability Lead
The Knowledge Transfer Network (KTN)



## Introduction

In considering resource efficiency, many have recognised the importance of 'business models' in enabling the return and reuse of valuable materials after a product has been sold and used. There are other factors driving changes in business models too, such as the rise of the digital economy, and the topic has therefore become prominent in the last few years. Some have suggested that it represents a major growth opportunity[78], and indeed one in which the UK is perhaps in a leading position. Others are less convinced, suggesting for instance that these models are nothing new.

> Business model innovation looks to move away from a conventional sales-oriented model towards one which extends the relationship with the product (and the customer) beyond that sale. This can keep materials in use and retain their capacity to generate continued value, rather than allowing them to disappear into landfill after a single use.

Such innovation can be driven from different parts of the supply chain. For instance, various initiatives have emerged specifically to realise value from a waste stream. Start-up Rype Office, for example, looks to exploit the opportunity to take back old office chairs and remanufacture them. Moving further up the value chain, Original Equipment Manufacturers (OEMs) like Caterpillar, Rolls Royce & Xerox have worked in collaboration with their customers, and their supply & distribution networks, to create a supply of materials that is more cost effective, and less subject to volatility, than the use of virgin materials.

There are major benefits of business model innovation beyond resource efficiency, including notable potential for carbon reductions and the creation of jobs. Other enablers and drivers of business model innovation include the rise of the digital economy, 'big data' and the internet of things, and the emergence of technologies like additive manufacturing.

> Business model innovation is not easy. It can be disruptive. It requires cultural change and typically demands sophisticated understanding of value across various points in the supply chain. One essential ingredient is trust-based collaboration – bridging functional boundaries within an organisation, across existing supply chains, and with new partners such as reverse logistics providers and third-party remanufacturers.

In the UK there are a variety of initiatives that are developing understanding of this important topic, and helping businesses big and small to make the transition to a different business model. But whilst many stakeholder groups are heavily engaged, could we be doing more to engage and incentivise more of UK manufacturers?

78 For a good account of this see Aston Business School (2013) Servitisation impact study. Available at: https://connect.innovateuk.org/documents/416351/3926914/Servitization+impact+study.pdf/

## Types of alternative business models

Broad categories[79] include:

- Leasing;
- Incentivised Return: A 'buy-back' arrangement where the manufacturer (or intermediary) offers to purchase the product back from the customer, for instance when it has broken or has been superseded by newer, more efficient models;
- Product-service systems: Also known as 'servitisation', where a charge is made to the customer for the use of a product based on the 'service' that it delivers. The equipment itself remains the property of the manufacturer, who is incentivised to design it for longevity and efficient service;
- Collaborative Consumption: Products and services are shared among those looking to utilise them at any particular time. Much enabled by digital technology and social media, we have seen over the course of a few years the creation of many new businesses adopting this model, some of which have grown to be among the world's biggest. For instance:
  - The world's biggest taxi company owns no taxis (Uber);
  - The largest accommodation provider owns no real estate (AirBnB).

All of these models offer the potential for resource demand reduction through the more effective use of the products of industry.

Without adopting these models, the value system will struggle to bring materials back and realise optimal value from their reuse. Business model innovation facilitates the tightest, most resource efficient loops of the circular economy – reuse, refurbishment, repair, and remanufacture. Without business model innovation, the potential for improvements is much reduced, and limited to the outer loops of the circular economy (eg. recycling).

## Benefits

Established case studies such as Rolls Royce, Xerox and Caterpillar are familiar (perhaps even overused) but have demonstrated that these models can work, and indeed work consistently over many years. This consistent use in financially successful businesses over decades proves that there must be real benefits to manufacturer and customer alike, in these sectors at least.

Not least among these of course is the potential for cost savings. Inevitably the success of these companies has inspired competitors in their respective sectors to try and replicate these business models. Thus in printers for instance, competitors including Kyocera and Ricoh have long operated using similar pay-per-page models to that employed by Xerox.

Penetration of this thinking on novel business models into other sectors and smaller companies, however, is perhaps less well established.

79 For a fuller account see APSRG (2014) Triple Win: The Social, Economic and Environmental Case for Remanufacturing. Available at: http://www.policyconnect.org.uk/apsrg/research

The World Economic Forum estimated that by 2025 a circular approach could benefit the global economy annually by some $1trillion dollars. Analysis at national level is more challenging, but Imperial College London and Veolia[80] recently estimated that circular economy methodologies could increase the UK's Gross Domestic Product (GDP) by £29bn or 1.8%, and create 175,000 new jobs. Servitisation is identified explicitly in their report, with a potential contribution of £3.1bn. Better metrics would undoubtedly assist in the appropriate measurement of the economic & resource benefits of a circular economy and this is explored in Chapter 10.

> It is clear that business model innovation can offer other benefits beyond the efficient use and recovery of resources.

These benefits include carbon reductions as a result of the capacity that business models like leasing or servitisation have to provide access to the latest, most energy-efficient technology. These technologies are often prohibitively expensive for the prospective customer to purchase through a conventional sales-based business model. Servitization ("pay-per-lux") models for lighting are a good example, implemented most prominently by Philips[81]. Moreover, in a servitisation model the whole value system is incentivised to design and deliver efficient and robust products and installations that meet all the customers' requirements. However the pay-per-lux model does not seem to have scaled as rapidly as one might have hoped, and the reasons for this are not necessarily clear.

## Collaboration

For any one organisation, changing their business model is likely to be one of the most radical forms of innovation that they could attempt, with widespread implications across functions such as product design, procurement, accounting, marketing and operations. (Several of these functions are explored in more detail in other chapters.) A shift in company culture will be required, and only a minority of companies have so far made this transition. It requires strong leadership and internal collaboration.

> In addition, the development of a novel business model typically has implications well beyond an individual company's boundaries, and therefore demands collaboration with a complex web of stakeholders as opposed to the simple linear transactions in a traditional supply chain.

Various stakeholders such as suppliers, the customer, logistics providers, retailers as well as indirect stakeholders such as designers, policy makers, academics and government will inevitably cover a spectrum culturally, with each potentially having a particular style and pace of operating, specific vocabularies, and different values. Each may have an important or indeed critical contribution to make, but these differences typically hinder easy collaboration. Organisations that make the effort to understand the roles, relationships and respective insights of the different stakeholders, and to extend or redefine their networks based on this understanding, are likely to be the ones that can successfully realise circular economy business models. Various recent reports explore this notion:

80 Veolia (2015) The Circular Revolution. Available at: http://www.veolia.co.uk/about-us/about-us/circular-economy/circular-revolution
81 Ellen MacArthur Foundation (2015) Philips & Turntoo Case Study Available at: http://www.ellenmacarthurfoundation.org/case_studies/philips-and-turntoo

- The concept of a network of stakeholders working together, instead of just a linear supply chain, is explored in a recent paper from Forum for the Future, Innovate UK and Capgemini[82]. It refers to concept using the term 'value network';
- Think tank SustainAbility's report (2015) on business model innovation for sustainability[83] notes that "Today, innovations are increasingly brought to market by whole networks of internal collaborators or even networks of firms that operate in a coordinated manner;
- A recent study commissioned by Jaguar Landrover[84] on remanufacturing stressed the value of external collaboration. One remanufacturer is quoted as suggesting that "Partnerships are the only way to get high quality remanufactured product at reasonable cost".

## Technology as an enabler

Technology can be an enabler of business models, and can indeed help with regard to this communication and collaboration.

Monitoring and communication technology appropriately embedded in products (the so-called 'Internet of Things') can generate enhanced insight into the use, performance and even location of products, and the behaviour of customers: Similarly digital technology and social media can be an enabler of the 'sharing' or 'collaborative' economy, as outlined above. Distributed manufacturing, where bespoke products are made locally, often utilising new technologies such as additive manufacturing, can also help bring producers closer to their supply chain and their customers.

Savortex are an interesting example of the use of technology as an enabler of novel resource efficient business models. They are a small company who have developed a hand dryer that is energy efficient and durable (it has an 'industry leading' 7 year warranty). They already offer the product on a lease basis, which facilitates return of the product, and are looking to extend this kind of business model. This is enabled by the addition of data gathering and connectivity as the product is used. This data provides knowledge about the user, and the way the product and surrounding system is used, which is valuable across various stakeholders, not least in terms of Savortex's future product development.

## Initiatives tackling resource efficient business model innovation

In the UK the notion of the circular economy has attained prominence in recent years, and there are many initiatives which are helping businesses tackle business model innovation for a circular economy (Table 1). All are looking to build a set of exemplars that prove the benefits, to understand the challenges and enablers, and to transfer knowledge into other businesses and sectors.

82 Forum for the Future et al. Innovating for a brighter future. Available at: http://forumforthefuture.org/sites/default/files/Value,%20Unchained%20-%20A%20short%20summary%20of%20value%20networks.pdf
83 SustainAbility (2015) Model Behavior II: Strategies to Rewire Business. Available at: http://www.sustainability.com/library/model-behavior-ii
84 Remanufacturing Research Project for Jaguar Land Rover. Available at: https://connect.innovateuk.org/documents/22449725/0/Remanufacturing%20Research%20Project%20for%20Jaguar%20Landrover%20-%20executive%20summary

Table 1: Initiatives tackling business model innovation

| Organisation/ Initiative | Activities |
|---|---|
| The Knowledge Transfer Network | Helps businesses to innovate by connecting them with collaborative partners, not least with regard to circular economy business models. Also involved in most of the following initiatives. |
| Innovate UK | Has run recent competitions on supply chain and business model innovation, resulting in approximately fifty projects (total value over £15m) investigating this theme. |
| REBus (Resource Efficient BUSiness models) programme | Led by WRAP this European programme aims to develop thirty exemplars of resource efficient business models. |
| Zero Waste Scotland | Has a Circular Economy Business Model programme. |
| The Manufacturer Magazine | Recently set up a Manufacturing Servitisation Thought Leadership Network and services award as part of the annual TMMX awards (won by Savortex, outlined above). |
| Aston Business School's Centre for Servitization Research and Practice | Has been engaging SMEs in making the transition towards more service-orientated business models. |
| The Scottish Institute for Remanufacture | Offer support on business models for remanufacturing. |
| The Remanufacturing Special Interest Group | Provides a focal point for remanufacturing in the UK. |
| The EPSRC Centre for Industrial Sustainability | Has developed a suite of tools to support business model innovation. |
| The Ellen MacArthur Foundation | Various reports, case studies and initiatives that feature prominent mention of business models. |
| Policy Connect | Reports featuring policy recommendations on business models including on remanufacturing and on industrial sustainability. |
| The Cambridge Service Alliance (a collaboration between Cambridge University, BAE Systems, IBM and others). | Collaboration between University of Cambridge, BIE Systems, IBM and others. |

Arguably these initiatives and the industry projects they are supporting are putting the UK at the forefront of the resource efficient business models agenda. The recent *Industrial Evolution*[85] report from the Manufacturing Commission, also within Policy Connect, suggests that:

> "The UK is a leader on thinking and analysis on how new business models can meet consumers' needs in more environmentally-friendly ways. Better implementation of these ideas could mean that they are something the rest of the world looks to the UK for."

This particular report also makes some useful policy recommendations relating to how to exploit this potential.

Though there are strong connections across the various initiatives outlined above, they do not always work together as coherently as they might. From a business perspective, the support landscape is fragmented and subject to regular change. As a result it will not be clear to any individual business at any one time where they might best go looking for support.

## Policy for resource efficient business models: engaging manufacturers

Legislation has of course played a role in tackling the problem of waste. However, as indicated in a recent report from Zero Waste Europe, this has not always been successful in driving a circular economy[86]. These factors are explored compellingly in APSRG/APMG's *Triple Win: The Social, Economic and Environmental Case for Remanufacturing* report[87].

> The starting point for these policy measures seems to have been recycling and how to deal with waste, whereas to realise the tighter loops of a circular economy, where the creation of waste is avoided, engagement has to extend throughout the full product cycle.

Although there has been much success in in recent years in engaging certain critical stakeholders in the system like designers, retailers, and the waste sector, more could perhaps be done to engage and incentivise other essential stakeholders, not least the full range of our manufacturers. It is essential that we fully involve manufacturers in order to realise the tightest possible loops in the circular economy.

Recent developments with the EU Circular Economy Package offer cause for optimism in terms of policy. For instance the adoption of a definition for the term 'remanufacturing' and a recasting of the definition of waste that avoids recovered products in transit being classified as such.

85 Manufacturing Commission (2015) Industrial Evolution: Making British Manufacturing Sustainable. Available at: http://www.policyconnect.org.uk/apmg/
86 Zero Waste Europe (2015) Redesigning Producer Responsibility. Available at: http://www.zerowasteeurope.eu/downloads/redesigning-producer-responsibility-executive-summary/
87 APSRG (2014) Triple Win: The Social, Economic and Environmental Case for Remanufacturing. Available at: http://www.policyconnect.org.uk/apsrg/research

Occasionally, manufacturers are perceived as the villains. This premise is that manufacturers make products that consumers use for just a short time and then dispose of; they are not designed for repair or indeed that they have obsolescence built in. However manufacturers can be heroes: the best of industry, of course, makes products that deliver high and enduring value – products that customers cherish and want to have repaired, upgraded, or sent to be remanufactured. Such manufacturers are, of course, typically the ones that have a profound connection to their customers, and indeed the rest of their 'value network'. Implementing the kinds of business model we've been discussing, that extend the relationship with the product beyond their factory gates are a great way of building this connection.

Initiatives and organisations like those outlined in the section above can provide a valuable contribution by bringing a fuller breadth of our domestic manufacturers into dialogue regarding the emerging circular economy, to build the kind of comprehensive value networks that will realise this vision.

## Conclusion

One of the most important ways of realising more efficient use of resources in the UK is to increase our focus on the tighter loops of the circular economy and to effect those measures that extend producer responsibility, and thereby return products to manufacturers before they become waste. This will enable reuse, repair, refurbishment or remanufacture. Business model innovation is needed to implement these at significant scale. This in turn demands collaboration across a range of stakeholders and a shift from linear supply chains towards the notion of 'value networks'. There are some solid exemplars that are leading the way, and some very compelling organisations and initiatives that can help get this knowledge out into other sectors and realise major benefits for effective use of resources, and for the UK economy.

# CASE STUDY: DEFRA RE-ENGINEERING BUSINESS FOR SUSTAINABILITY

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## DEFRA

Led by the University of Hertfordshire, the Department for Environment, Food and Rural Affair's (Defra) 'Re-engineering Business for Sustainability Project' is piloting an innovative Product Service System (PSS) model based on the rental of baby care products such as prams and car seats. The pilot was initiated in January 2014 by Maurizio Catulli's team at the University of Hertfordshire in collaboration with Dorel UK Ltd and the National Childbirth Trust (NCT).

> A PSS is a system of products, services and supporting infrastructure designed to be more resource efficient than traditional business models[88]. With PSS, the use of a product is accessed without necessarily transferring ownership to the consumer, in other words the utility delivered by a product is accessed as if it were a service.

The pilot seeks to develop a deeper understanding of consumer attitudes to the model as well as the wider social, economic and environmental benefits it can deliver.

In this sense, PSS is viewed as a type of sustainable service innovation. Experts maintain that PSS is a pathway to a circular economy and presents considerable environmental and social benefits. It avoids product proliferation by extending products life cycles, with reduced raw materials consumption; it enables sharing of products, with financial benefits for consumers; it enables providers to maintain control over products during their life cycle and therefore minimise environmental impact by increasing the percentage of products that are returned for reuse, refurbishment and remanufacturing, therefore decreasing their probability of being disposed of in landfill.

The pilot has been designed and set up in collaboration with Dorel, a major manufacturer of baby care products, and the NCT, after a feasibility study initiated in January 2012. The project has circa 700 participants who are renting in excess of 900 baby care products. At the end of each rental period, the consumer can either extend the agreement for another period or return/amend the package. The products are then refurbished to standard EN 1888: 201 (like new) and sent out to new consumers. A number of products have achieved three cycles of use.

Throughout the pilot, information is being gathered on customer satisfaction and product attrition (damage to products which could affect financial viability). This is providing a wealth of information on both the potential benefits of the model but also the challenges relating to reverse logistics, product design and technical capacity/ infrastructure required to sustain the system.

The final report will be published in early 2016[89].

88 Mont OK. (2002) Clarifying the concept of Product Service System Journal of Cleaner Production 10: 237-245.

89 Initial outputs from the ongoing pilot can be found on the project website at: http://rebus.org.uk/

# Experts maintain that Product Service System (PSS) is a pathway to a circular economy and presents considerable environmental and social benefits.

# CHAPTER 7
# WASTE MANAGEMENT: PAST, PRESENT AND FUTURE

**Dr Dominic Hogg**
Chairman
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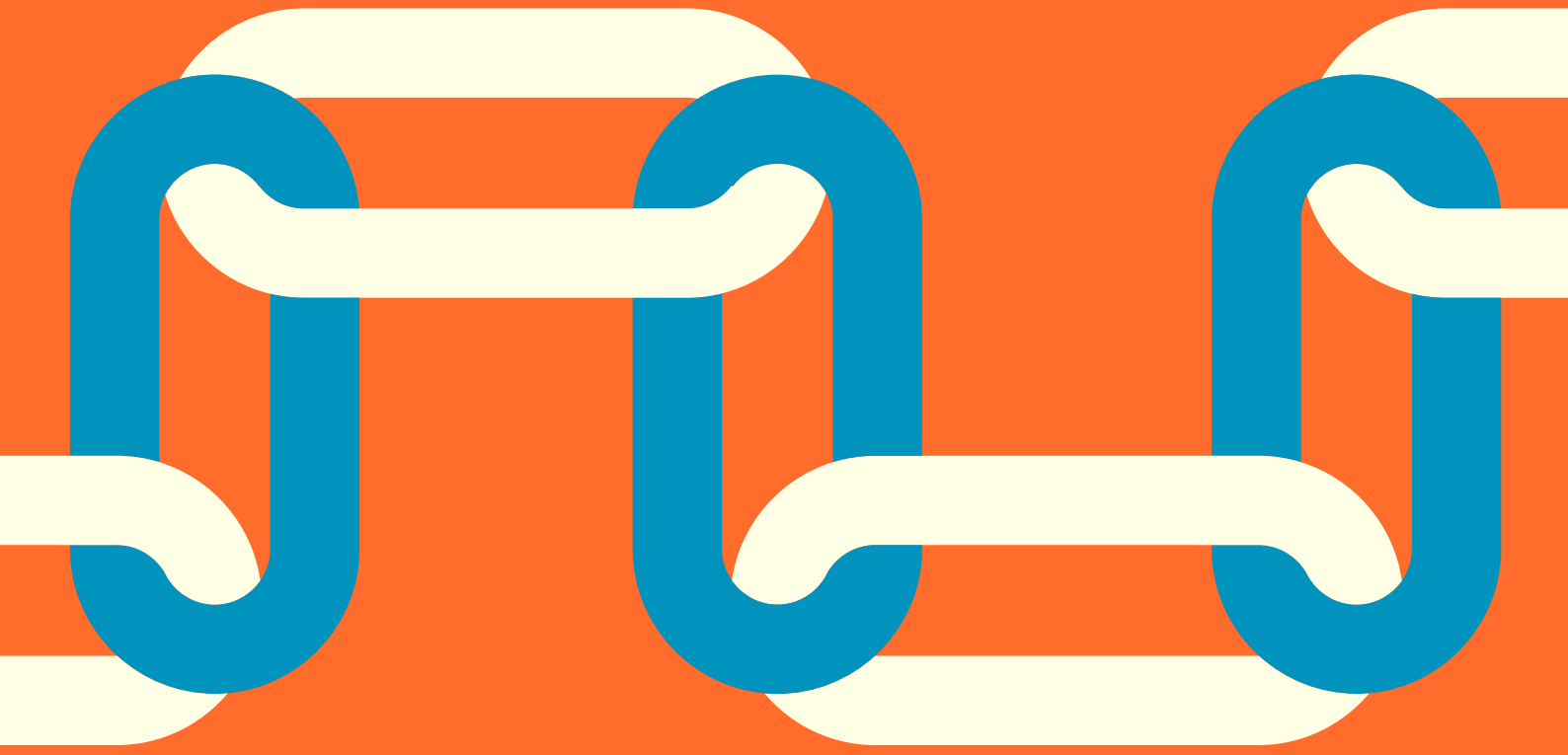

At the beginning of the last decade, the vast majority of 'stuff' that was being accumulated by households, and that they didn't want any more, was finding its way to landfill. Everything about 'waste management', in the way we had come to understand it, seemed wrong. We expected someone to supply us with a service where someone would come to our house and take away all the stuff that we had managed to accumulate over a given period, and that we no longer want. We didn't really care much where it went.

In terms of supply chains, there wasn't too much thought given to the role of 'waste management' as part of any chain, let alone, one related to supply of raw materials for industry. I don't think more than a few moments' consideration is necessary to understand that it has never been true that the economy has been 'everywhere linear', however popular it might have become to portray the economy in that way. However, the connections between different actors involved in managing waste and resources have definitely not been fully appreciated or concretely established.

To the extent that 'supply' has preoccupied waste companies in the recent past, the 'problem' has tended to be conceived in terms of 'how much waste will come to my treatment facility?', and how a certain quantity of waste can be secured for treatment. This might all be very well in the early days of the development of more formal recycling systems, but it clearly does not sit well with wider sustainability objectives once the emphasis shifts away from disposing and treating of waste, and towards the upper tiers of the waste hierarchy. How, after all, should a waste company engage with a system that is genuinely seeking to prevent waste, and where the aim is to keep resources in the chain of utility for as long as possible?

## The past

The institutional economist, Thorstein Veblen wrote, in his seminal work, *The Theory of the Leisure Class* [90]:

> "The basis on which good repute in any highly organised industrial community ultimately rests is pecuniary strength; and the means of showing pecuniary strength, and so of retaining a good name, are leisure and the conspicuous consumption of goods. Accordingly, both of these methods are in vogue as far down the scale as it remains possible; ...
>
> ... the utility of both [leisure and conspicuous consumption] alike for the purposes of reputability lies in the element of waste that is common to both."

You might like to take issue with the concept of trickle-down economics, but the fact that so many of us now have purchasing power that allows us to do far more than satisfy our basic needs enables us 'to waste' on a scale that Veblen could scarcely have imagined.

The 'waste industry' has thrived on the back of our conspicuous consumption. But if such consumption was a means to demonstrate wealth and status at the end of the nineteenth century, then looked at through the lens of future historians, such consumption will surely be viewed as folly, an aberration that took humanity to the brink (and let's hope we can pull back from it) of the collapse of ecosystems and the life-support they provide to us.

90 Thorstein Veblen (1994) The Theory of the Leisure Class: An Economic Study of Institutions, London: Constable and Co. (first published 1899)

## The present

Quite a lot has changed over the last fifteen years. Much is made of the need to move towards sustainable materials management, or a circular economy, but the UK economy is already much more circular than it was. No doubt there is still enormous room for improvement (albeit that some of the very large, headline grabbing numbers emerging from various oft-cited studies are country miles wide of the mark), but it's worth considering what these changes mean for the waste industry, and what they might mean in future.

> A highly significant change in the UK has been the fact that 'waste companies' are affected by commodity prices. As more waste moves into recycling streams, the revenues from the sale of recyclables become more significant. This means that the net cost of managing waste is more significantly influenced by the revenues received from the sale of the secondary materials (e.g. plastics, metals, paper, textiles, glass) being collected. In particular, as collection services are being made more efficient (with spending on collection of residual waste being pared back), this becomes ever more apparent.

The argument put forward by some, that a circular economy was 'inevitable' because commodity prices were, henceforth, going to be both high and volatile (these two descriptors were always going to be uneasy bedfellows), more or less collapsed as soon as it was made. This line of argument was always hubris, and the precipitous decline in demand from China just as suppliers were tooling up has simply made this more obvious. It doesn't mean that prices will always be low, merely that it was, and is, foolish to assume they will always be high. Volatility remains a characteristic of commodity price movements, and whilst it might be of some passing interest to understand whether these are more or less volatile than they used to be, the main issue for waste companies is that their activities are, to an increasing extent, going to be linked to commodity prices.

For waste companies, to have made the assumption that commodity prices would stay high, albeit still volatile, would have led to disaster over the years since many commentators confidently predicted that a new era of resource scarcity was upon us, unless the company was engaged in activities largely delinked from commodity markets. Given that waste companies are increasingly collecting and managing materials for recycling, few forward-thinking companies in the UK would not be exposed to commodity markets in some way, notwithstanding the attempts to develop risk-sharing mechanisms.

In municipal waste contracts, the within-contract-period variation in commodity prices has become a critical factor to be managed as recycling rates increase, and the amount of residual waste available declines. Elsewhere, we have suggested a number of mechanisms that could be deployed for this purpose, and these include shifting commodity price risk to producers through the producer responsibility mechanism. The rationale for this seems reasonably obvious: producers are already engaged (directly or indirectly) in buying and selling commodities used in production, and are more likely to have mechanisms in place to deal with commodity price movements. Producers also need to take responsibility not only for funding the management of products and materials at their end of their life, or lives, but also, for shoring up demand for materials and products that are extracted from the waste stream.

Another consequence of the increased exposure to commodity price risk is that waste companies have started to look, and behave, more like manufacturing companies. Not least in times when demand for materials drops generally, the demand for secondary materials may also decline . This is particularly the case if there is no compelling mechanism for a preference to be expressed for secondary over primary materials. Since the users of material can become more discerning (with regard to quality) when supply outstrips demand, the focus of what we might term secondary raw materials manufacture shifts to product quality. More than ever, issues of process optimisation and quality control, as means through which to exert control over quality of outputs, are becoming more important.

## The future

An obvious conundrum for the waste industry might be how it can deal with commodity price risks in future. Retreating back down to the lower tiers of the waste hierarchy is obviously not a direction in which we want to travel. That having been said, whilst no waste company would want to be seen openly rejecting the desirability of moving waste up the hierarchy, in England, in particular, it remains the case that government needs to better support this notion. It appears that the Waste (England and Wales) Regulations are simply not being enforced.

Not all things that become 'waste', either now or in the future, are likely to be amenable to approaches any more circular than recycling. Suppose that manufacturers of packaging and of products became interested in obtaining as much of the secondary materials in the waste stream as they could – and the secondary plastics market at a time of low oil prices suggests we are very far from this – then in principle, manufacturers might become more interested in 'take-back' for their own use. The role of waste companies would be significantly affected by such a shift. Mechanisms which might find favour would be those such as deposit refund schemes which effectively incentivise return of the packaging or product at the end of its useful life.

Trade-in deals already encourage consumers to bring items undamaged to stores, allowing greater recovery of product residual values (for example through subsequent sale to secondary markets in the UK and overseas) whilst also increasing footfall and gaining further sales. As has already been seen in this collection, Argos has recently adopted this approach for certain product groups while some manufacturers, such as Bosch, offer trade-in deals against their new products. Re-tek in Scotland works with businesses to incentivise return of ICT equipment, through a rebate, allowing 80% to be reused after appropriate refurbishment and data cleansing. On the supply side, ICT asset management companies lease ICT and other equipment to businesses and public sector organisations, and have always operated a more circular business model, with a clear incentive to optimise equipment life and maximise residual value at end of life.

If the focus has been heavily on recycling in the recent past, what are the prospects for moving further up the waste hierarchy in future? Suppose that so-called new circular economy business models (perhaps more properly understood as old ones applied to new things) take off more widely, and that these are aligned with eco-design (see Chapter 5). Then, it seems reasonable to argue that the model might stand or fall on the ability of the manufacturer to manage the reverse supply loop in a way that ensure

logistics are efficient, and that they have minimal impact on the ability of the product to be repaired, remanufactured, used for parts, etc. In this scenario, the emphasis shifts away from the commodity value associated with materials, and increasingly towards the embodied value added in products and parts thereof. In principle, these values might not fluctuate as wildly as commodity prices, but the same issue would remain as with recycling: the logistics provider would want their exposure to the risk of fluctuating revenues to be minimised.

We are, it seems, still some way from this, with some glaring examples of wastage still taking place in areas such as the product returns from consumers to retailers. Perfect, as new products are often returned to retailers for various reasons and mostly without any genuine fault, yet by the time they arrive back at sorting and assessment centres, many are damaged and uneconomic to repair. The management of the reverse logistics in general is often poor, and of course, the emphasis should rightly be placed on how to minimise the extent of those returns in the first place; through better communication with customers and improved product specification and design for durability/reliability.

> All of these models and others will play an important part in making 'waste' an asset and economies more circular, with waste management companies becoming more like asset management companies in the process.

## Conclusion

Just as commentators from the design perspective have highlighted the apparent lack of appreciation, on the part of product designers, of the effect of their decisions on the fate of their products at end of life, so the same problem exists in respect of the economics.

> A circular economy is not only about the technical challenge of designing things in such a way that they can be reused, repaired, remanufactured or recycled, but about ensuring the economic viability of the system that is designed to ensure that materials and products are managed in the best way. In the same way as we need more collaboration and understanding between designers and end-of-life managers, there is also an urgent need for collaboration to be undertaken to shore up the economics of the logistical loops that will be central to the circular economy.

Waste management companies are already being buffeted by winds of change as they collect more materials, which they need to place in markets which are characterised by volatile price movements. The circles and loops that society is seeking to close are vulnerable to these movements, so much so that such movements can break loops, or prevent them from being closed. If we are to make our economy increasingly circular in future, then the management of logistics, and the mechanisms through which the value of what is collected (whether it is destined for reuse, repair, remanufacturing, etc.) is realised within the supply chain, needs to be thought through. This is easily rectified where manufacturers take back their own products: it is less straightforward the more those conducting the logistics are separated from those who want the products or materials they collect. We don't just need new business models in terms of production of goods and services: we also need them to ensure that the inner circles of the circular economy are completed in as many places, and for as many products, as possible.

# CASE STUDY: FURNITURE REUSE NETWORK

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## FURNITURE REUSE NETWORK

The Newbury Community Resource Centre (NCRC) helps local people in need by providing furniture, goods and services at low cost. The organisation also provides opportunities for people to develop work and social skills through volunteering and encourages environmentally beneficial activities by promoting recycling and reuse.

The NCRC sources products for reuse from most waste streams including household, WEEE (Waste, Electrical and Electronic Equipment), commercial, industrial and producer take back (i.e. John Lewis, IKEA). From 2004-2008 they operated a waste collection service from the Household Waste Recycling Centre (HWRc) through an SLA with West Berkshire Council, however they had no on-site presence and worked from a 'shed'. In 2008 West Berkshire Council procured a PFI deal for all waste services over 25 years and NCRC lobbied for the inclusion of 'reuse clauses' which were agreed and were included in the specification. Veolia were the successful contractor and committed in their bid to work with NCRC to continue and improve the reuse service at the HWRc site in Newbury and a new SLA was signed. A small annual payment is made by West Berkshire Council for the service.

NCRC operate a donation point (a large self-contained building) at the West Berkshire HWRc manned by their own staff and volunteers to enable residents to donate suitable furniture, other household items and electrical goods for reuse. The NCRC team provide an excellent customer service for residents by helping carry items from cars and discussing how the product will be reused or treated. They assess the suitability of the goods on site and on a daily basis remove suitable items by 3.5 tonne vehicles for reuse at their centre in Newbury. All unsuitable donated items are placed in the appropriate recycling facilities located on site and subsequently provide the Council with monthly figures of the weight of items diverted to reuse from the HWRc.

The HWRc site generates around 40% of the furniture and 50% of the electrical items reused by the NCRC. Other outputs from the operation of this service includes the production of evidence notes, employment, training opportunities, reuse credits, a small surplus to invest in social outcomes and the opportunity to promote the environmental message to residents of West Berkshire. In terms of environmental impact 637 tonnes of furniture and electrical items are diverted from landfill to reuse resulting in an estimated carbon credit of 2,364 tonnes of $CO_2$ emissions.

# CHAPTER 8
# SUPPLY CHAIN METRICS

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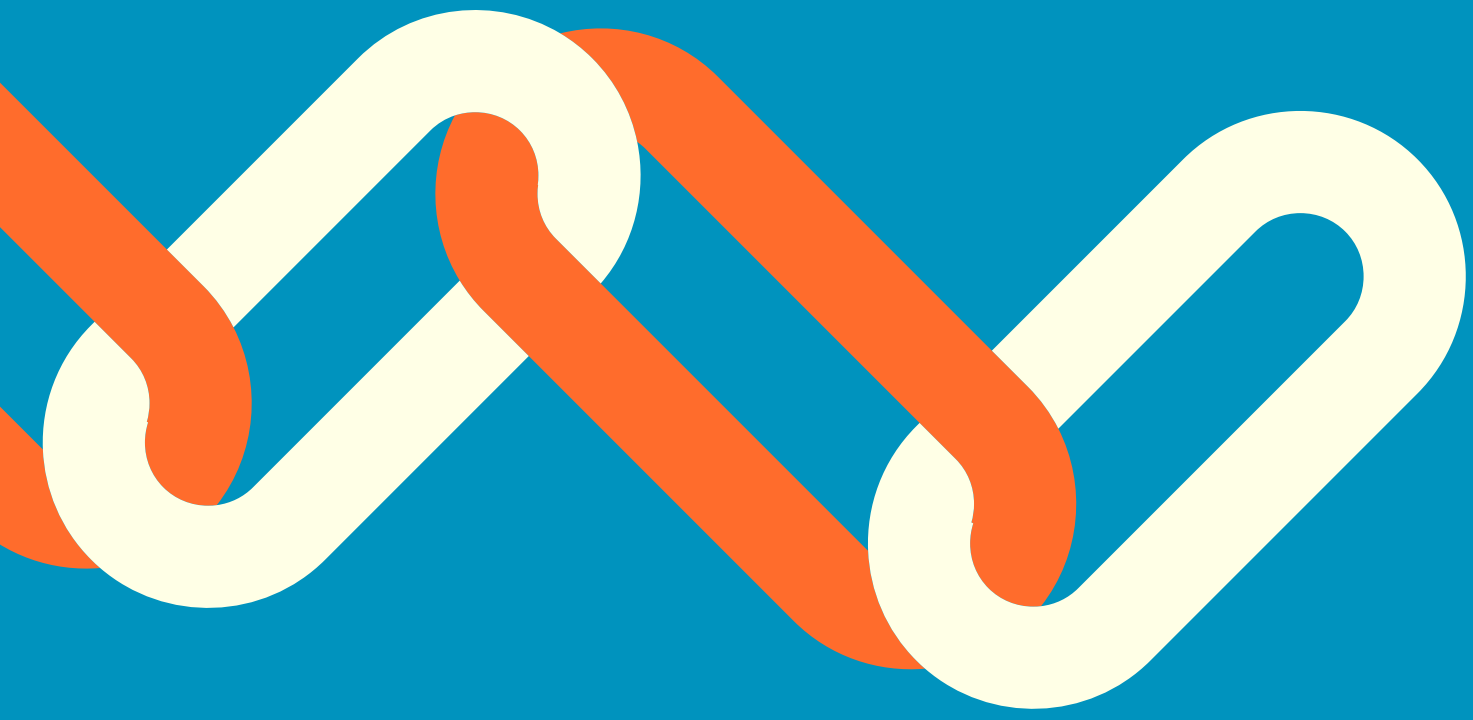

This chapter emphasises the importance of identifying the right waste and resource efficiency metrics for each supply chain. Despite the key role of supply chain metrics in advancing a circular economy, there is no universally suitable or accepted system and therefore no solid basis to develop generalised policy or guide firms. We conclude by recommending collaboration between supply chains, government and researchers to develop programmes which put metrics in the context of the sector, region and organisational type.

## Benefits of waste and resource efficiency metrics

Waste and resource efficiency metrics are essential to enable producers to manage their resources and products efficiently and in an environmentally responsible manner. Metrics help firms realistically evaluate performance trends and risks over time, define objectives and targets and track relative performance with a degree of accuracy. Metrics have the potential to enable identification of aspects that can be improved to make products or processes more resource efficient, such as the percentage of re-manufactured/recycled materials used or the amount of waste created. They also facilitate transparent reporting of the organisation's performance; assist benchmarking and undergird effective collaboration with stakeholders[91]. From a policy perspective, metrics can be a crucial input for well-designed regulatory incentives and targets. Effective metrics and targets embedded in European legislation have fostered innovation in recycling and reuse, constrained landfilling, decreased losses of resources and provided incentives for behavioural change.

A 2014 European Commission communication paper offers a good basis for understanding the drivers for good metrics. 'Towards a circular economy[92]: a zero waste programme for Europe', compels the region to transition to a fully resource efficient economy[93] using multi-tiered supply chains[94].

Advantages include:

- Organising flows of re-used and recycled materials, measuring both:
  a. The capabilities of companies to generate a predictable supply of waste that can be used as resource, and;
  b. The emerging demand for recycled, remanufactured and re-used materials;
- Facilitating a more open and transparent communication between supply chain firms, leading to a co-operative supported work environment and hence improved organisational performance;
- Effective monitoring and control of progress towards a circular economy;
- Despite these evident advantages of supply chain metrics, there remain nevertheless considerable challenges to achievement.

91 ISO 14031, Environmental Performance Evaluation, Available at: https://www.iso.org/obp/ui/#iso:std:iso:14031:ed-2:v1:en

92 In a circular economy, the aim is to eradicate waste and maintain value added for as long as possible. Waste is eliminated because one company's waste becomes a resource pumped back into productive use for another company. The EU forecasts that Resource Efficiency improvements along the supply chain can reduce material input needs by 17-24% by 2030 while boosting EU GDP by up to 3.9%.Waste efficiencies in supply chains can save an equivalent of 8% of EU business annual turnover and reduce emissions by 2-4%. Available at: http://ec.europa.eu/environment/resource_efficiency/pdf/working_paper_part2.pdf

93 European Commission (2014) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on 'Towards a Circular Economy: A zero waste programme for Europe'. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52014DC0398

94 APSRG (2014) Triple Win: The Social, Economic and Environmental Case for Remanufacturing. Available at: http://www.policyconnect.org.uk/apsrg/research

## Challenges of waste and resource efficiency metrics

Although firms, scholars and policy-makers agree on the need for specific supply-chain metrics, there are no consensually accepted metrics in place for supply chain auditing and reporting in resource efficiency and waste management. Neither is there agreement about what firm-level resource efficiency metrics can be used as a starting point to develop supply chain indicators. ISO 14031 and The Global Reporting Initiative (GRI) are two obvious sources of firm-level environmental metrics for companies, but the academic literature offers a myriad of alternatives claiming to provide better or more specific metrics. A literature review identified 148 different metrics used to measure solid waste generation, and 140 metrics dealing with recycling (Ahi and Sehay, 2015). The multiplicity of measures and controversy is partly explained by industry and product specific issues (recycling of phosphorus is a key metric for waste management in the food industry; while for the construction industry metrics on recyclability and recycled content are priorities); and partly because there are three different types of metrics: Absolute, Relative and Contextual which are particularly relevant to understand why the resource efficiency/waste management performance of large firms and SME may require different metrics

Absolute metrics measure gross outcomes during a fixed period of time, such as total hazardous waste generated in a year. Relative metrics record performance in terms of other variables, for instance tons of waste recycled per unit of production, or employee. Large companies producing millions of units can showcase huge reductions in waste even when actual improvement per unit is marginal. In the case of SMEs relative metrics provide a more balanced picture of progress in resource efficiency. Contextual metrics express performance in terms of contextually relevant social, economic or environmental boundaries. Contextual metrics are recommended by the GRI as they follow the Sustainable Context Principle: “Performance should be assessed on the context of the limits and demands placed on environmental or social resources at the sector, local regional or global level” (GRI, 2013, 17). For example, waste to landfill should be measured against limits in land availability; percentage of use of remanufactured/recycled materials should be measured against the criticality of the material in terms of availability of reserves; and percentage of waste incinerated should be measured against air pollution thresholds in a particular geographical area.

> The Global Reporting Initiative emphasises that supply chain resource metrics needs to include all three types of metrics, but Contextual metrics are the most important to measure progress towards a circular economy.

Contextual metrics are also important to showcase the impact of SMEs. The resource efficiency/waste performance of SMEs cannot be assessed on an individual basis, nor in a decontextualised basis. In some contexts the accumulated poor waste management performance of SMEs constituted a serious risk (Vazquez-Brust et al, 2010). A cluster of SMEs each dumping small amounts of waste to a river or increasing air pollution when incinerating waste (even with energy recovery) can have devastating cumulative effects on the health of the socially vulnerable. More needs to be understood in terms of measuring how clustering of suppliers amplifies total supply chain impacts. Furthermore, although a myriad of metrics and systems are available, it is unclear what metrics are actually used by SMEs and to what extent any of them actually work. Most studies are conceptual, case studies of large firms or surveys with very low generalisability. More conceptual clarity and more robust empirical evidence at the supply chain level and regional/national level is needed.

Despite the importance of contextualised measurement, absolute metrics outnumber relative metrics whereas contextual metrics are few and far between. Selecting the right set of measures is crucial since no metric will apply equally well in all circumstances (Ahi and Sehay, 2015). However, there remains too much choice in some aspects and not enough guidance on how to identify key metrics, collect or process them. We will focus on two useful but imperfect approaches that can be used as a starting point to help firms (both large and SMEs) improve raw material use and waste management efficiency in the supply chain.

## Two examples: resource productivity and zero waste to landfill

According to the European Commission, key metrics in a circular economy are resource productivity (GDP/ Raw materials Consumption) with a target of 30% reduction by 2030 and waste to landfill: with a target to virtually eliminate landfill by 2030[95]. Zero waste to landfill implies a hierarchy of waste management: reduce (redesign to eliminate waste), reuse (return to suppliers or reuse in same/different process), remanufacture (processing and selling to third parties), recycle-compost, anaerobic digestion, recovery or waste to energy (combustion to generate clean / renewable energy), combustion without generation of energy and landfill. According to the Commission, the latter two are considered unacceptable, while recovery should not exceed a limit of 10% of total waste divested from landfill. Metrics used are absolute: amount of waste (in tons and as % of the total) divested from landfill using each option and per each waste stream along the supply chain. Desirable targets for each type of diversion option vary according to the nature and composition of inputs[96]; types of products, size of the company and type of solid stream. For instance, there are legislative barriers around remanufacturing and recycling paint through the REACH legislation, which can act as a barrier to creating a more circular model around paint products.

Zero waste to landfill is an approach increasingly favoured by large multinationals such as Unilever and Toyota, which apply it to set standards for its suppliers' resource efficient and waste management performance. Such company-own indicators are flawed by a design that only aims to replicate the focal company sustainable metrics across the multi-tier supply chain (Hartmann and Moeller, 2014). Subramanian and Gunasekaran (2015) argue that it is essential to develop relative metrics that link waste/resource efficiency measures/investment to basic aspects of supply chain management: productivity, revenue growth, risk mitigation. This is still wanting on Zero waste to landfill based metrics. An attempt to achieve the latter is GREENSCOR, the environmental performance module of the Supply Chain Operations Reference Model (SCOR). SCOR is the most widespread model to diagnose and report supply chain performance (Hwang et al, 2010); its Resource Efficiency Metrics are relative and include waste as percentage of production output and ratio of returned products that are remanufactured to returned products that are disposed as waste. The model also highlights a number of industry best practices and processes to make the supply chain greener and more resource efficient, from collaboration with suppliers, load maximisation, identification of recyclable material, and techniques to collect and handle waste from production and testing (i.e. scrap metal and nonconforming products) (SCC, 2010). However, although SCOR serves as an effective diagnosis

95 Data available at: http://ec.europa.eu/eurostat/web/environmental-data-centre-on-natural-resources/resource-efficiency-indicators
96 For instance, if inputs are designed to be fully recyclable/reusable as is the case for nylon fibre carpets, the percentage of waste incinerated should be zero.

tool to evaluate and benchmark environmental performance in supply chains, it has two important limitations as a resource efficiency metric: a) its environmental metrics are rather generic, glossing over industry-specific environmental concerns (e.g. presence of sulphates in food waste – a key concern for EU policy) (b) it targets facility-level assessments and does not take into account variation in product profiles (i.e. life, value, weight, embedded toxic substances, ratio of raw to remanufactured inputs) (Boukherrob et al, 2013). A common problem with Zero-Waste-to-landfill and GREENSCOR is that they lack contextual metrics, which substantially hinders the quality of the measures in terms of sustainability reporting.

## Conclusion

Resource efficiency and waste metrics should be developed in each supply chain to reflect their particular business context with specific relative and contextual metrics taking into account the impact of supply chain practices in society and the performance of the supply chain compared to an industry average.

Importantly, when the focal company is an SME it will be constrained by lack of influence and financial and human resources to develop and disseminate its own evaluation scheme (Spence and Bourlakis, 2009). Moreover, a majority of supply chains commonly include second tier and first tier suppliers participating in more than one supply chain and selling to several focal companies. In some cases, the supplier has superior bargaining power owing to expertise or scarcity of competitors (Liu et al, 2014). Even if the SME succeeds in the collection of indicators, it will be unlikely to be able to resource managing the data, assessing its relevance or reporting on it systematically.

On the other hand, SMEs are highly skilled in using interpersonal networks to gather the information they need to remain competitive in the market; they are more flexible in decision-making, quicker to respond and more effective at cooperating with employees than large companies (Baumann-Pauly et al, 2013). SMEs have the skills required to effectively integrate environmental evaluation schemes based on their relationships within the supply network (Walker and Jones, 2012). SMEs can simplify data management and enhance quality of reporting by focusing on the most important topics and metrics for their business (BIC, 2003). If they are supported by their trade associations and the government with training and evidence-based information, SMEs are as capable as large companies to develop their own metrics. These will be necessarily and appropriately narrower than those for large firms. The case study in the chapter is an example of government support to develop evidence based metrics and its lessons can guide designing relative and contextual supply chain metrics.

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# CASE STUDY: WASTE INDICATORS IN WELSH SMES

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The beautiful Welsh countryside hides a serious problem of limited landfill capacity and an alarming level of waste generation. In a bid to tackle this, the Welsh Assembly supported research which surveyed over two thousand firms with over ten thousand waste streams. SMEs rarely report externally on their environmental practices, nor do they achieve recognition through environmental awards. The focus of the study which was conducted by researchers Jerónimo de Burgos-Jiménez, Diego Vázquez-Brust, José A. Plaza-Úbeda and Jeroen Dijkshoorn, was to take the SME perspective and to understand what type of metrics should be collected by focal companies to enhance resource efficiency through better understanding of:

a. Quantity of inert and toxic waste in supply chains;

b. Opportunities to reuse waste as input for other firms;

c. Improvements in financial performance and competitiveness resulting from reduction of waste to landfill.

The concept of environmental protection was unpacked into three different core dimensions: practices companies do to protect the natural environment (Environmental Management), the company's strategic orientation on environmental issues (Environmental Proactivity) and the real effects on the environment of firm activities (Environmental Performance). Environmental management was measured with absolute metrics, environmental proactivity with relative metrics and environmental performance with contextual metrics taking into account environmental impact and industry performance.

> The results of the study showed that while environmental management has no significant effect on medium-term financial performance, both environmental proactivity and environmental performance have positive effects on a firm's medium-term financial performance.

Much was learned about the suitability of different supply chain metrics:

- Tools based on qualitative practice-based metrics have limited usefulness to measure the degree of economic performance improvements;
- Metrics for waste management in SMEs are likely to provide better information about quality of waste management and its impact when they are: a) collected by stream of waste identifying total weight and waste management solution; b) analysed using relative, context based and impact-weighed indicators;
- Disclosing information by stream of waste increases transparency and signals commitment to enhance performance. It also boost synergies as other firms can identify opportunities to use the focal firm's waste as raw input in their own processes. For example, data from this project was used by firms in the construction industry to identify sources of glass waste (hospitality industry) to be used as aggregate in concrete mixes;
- Companies can simplify data management and analysis by focusing on the measurement and monitoring of two waste metrics which are crucial to maintain competitive advantage in the supply chain: The *waste management proactivity indicator,* and *The Industry relative waste management performance indicator*.

The waste management proactivity indicator is measured as the quotient between generated wastes with valorisation and total waste. Industry Relative Waste Management Performance is calculated as the ratio between the average, hazardous impact-weighted waste emissions per employee of the sector and the total hazardous impact-weighted weighted tonnes of waste per employee generated by the firm.

Concluding recommendations were that practitioners and researchers should use environmental performance indicators compared with the average of its industry if they want to predict effect on financial performance. Therefore, public authorities, which collect environmental information from firms, should promote the compilation and publication of average standards of environmental impact per sector. For instance, in our study wood products firms generated an average of 83 tonnes of solid waste per employee per year while many service firms (banks, insurance, post and telecommunications) generated an average less than 1. This would allow firms to know their situation better, while providing social pressure groups with a more objective view of aspects of environmental impact.

Source: Burgos-Jiménez et al (2013), Environmental protection and financial performance: an empirical analysis in Wales, International Journal of Operations & Production Management, 33, 8, 981-1018

# CASE STUDY: INTEGRATED RESOURCE PRODUCTIVITY THROUGH THE SUPPLY CHAIN

DR MICHAEL GELL
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GREENCLICK

## The Problem

With climate change already making its impact felt, there is an urgent need to act - to keep global warming to about 1.5°C or face impacts over the coming decades. Businesses in California, for example, are already experiencing water rationing as drought and wildfires continue. Regular flooding within the UK is now impacting supply chains as commercial and industrial sites are flooded, with food factories being affected for extended periods on account of hygiene requirements. These types of challenges mean that businesses and their supply chains will need to build resilience to adverse conditions and an important way of achieving that is to be more productive with the fewer resources that may be available to them.

With agreements such as COP21 and the Sustainable Development Goals, as well as new price signals based on carbon pricing, there is likely to be increasing pressure on business to be smarter about how they and their suppliers use resources. The basic resources are energy, water and materials and the ways in which each is used (and wasted) can have important effects on the other two. We need smart technology now to tackle climate change, and much of it is likely to focus on resource productivity.

## "Greenclick"

Some approaches to minimising material waste do not take into account the underlying root causes of the waste. In some cases, the root cause can be related to inefficiencies in energy and water use at a site and unless those are addressed the material waste will remain 'locked' into the system. Although many forms of materials and product waste are connected to energy and water use, many are unconnected and are more a reflection of operator behaviour, housekeeping and contractual arrangements.

> The Greenclick approach to waste reduction is based on integrated resource productivity. It is by addressing all three productivities (energy productivity, water productivity, and materials productivity) that a more informative picture can be established of the root causes of waste and how they inter-relate and what can be done to reduce it.

Greenclick uses savings search engines and decision support systems to benchmark materials and product waste combined with energy and water productivity, especially at production sites. The approach is not restricted to a single site and can be used across multiple supply chains.

The starting point in integrated resource productivity is to provide visibility of energy and water use as well as opportunities for energy and water reduction. In terms of materials and product waste, manufacturers and sellers make decisions that cause waste to arise within their own or others' organisations. Each organisation can address waste within their organisation, but there is a danger of moving waste around from one area of the supply chain to another.

Sector resource productivity, energy productivity, water productivity and materials productivity are all addressed together at Greenclick, and not in silos.

## Benefits

The Greenclick approach to resource productivity recognises two broad areas of resource productivity. One area is characterised by connections between energy, water and materials waste and begins with the use of productivity estimators for energy and water and is supplemented by process, product and costs models and on-site reviews to estimate materials productivities. The other area is characterised by productivities which may be independent of each other, such as materials productivity that is hampered by poor contracting and purchasing arrangements. An example of this is over-stocking of supermarket shelves with food with short use-by dates.

Integrated resource productivity provides companies with a new lens to address productivity through the supply chain. It can help organisations work collaboratively through the supply chain to reduce waste, reduce greenhouse gas emissions and save costs. This will become increasingly important in addressing the climate and resource challenges which we face.

# CONCLUSION AND RECOMMENDATIONS

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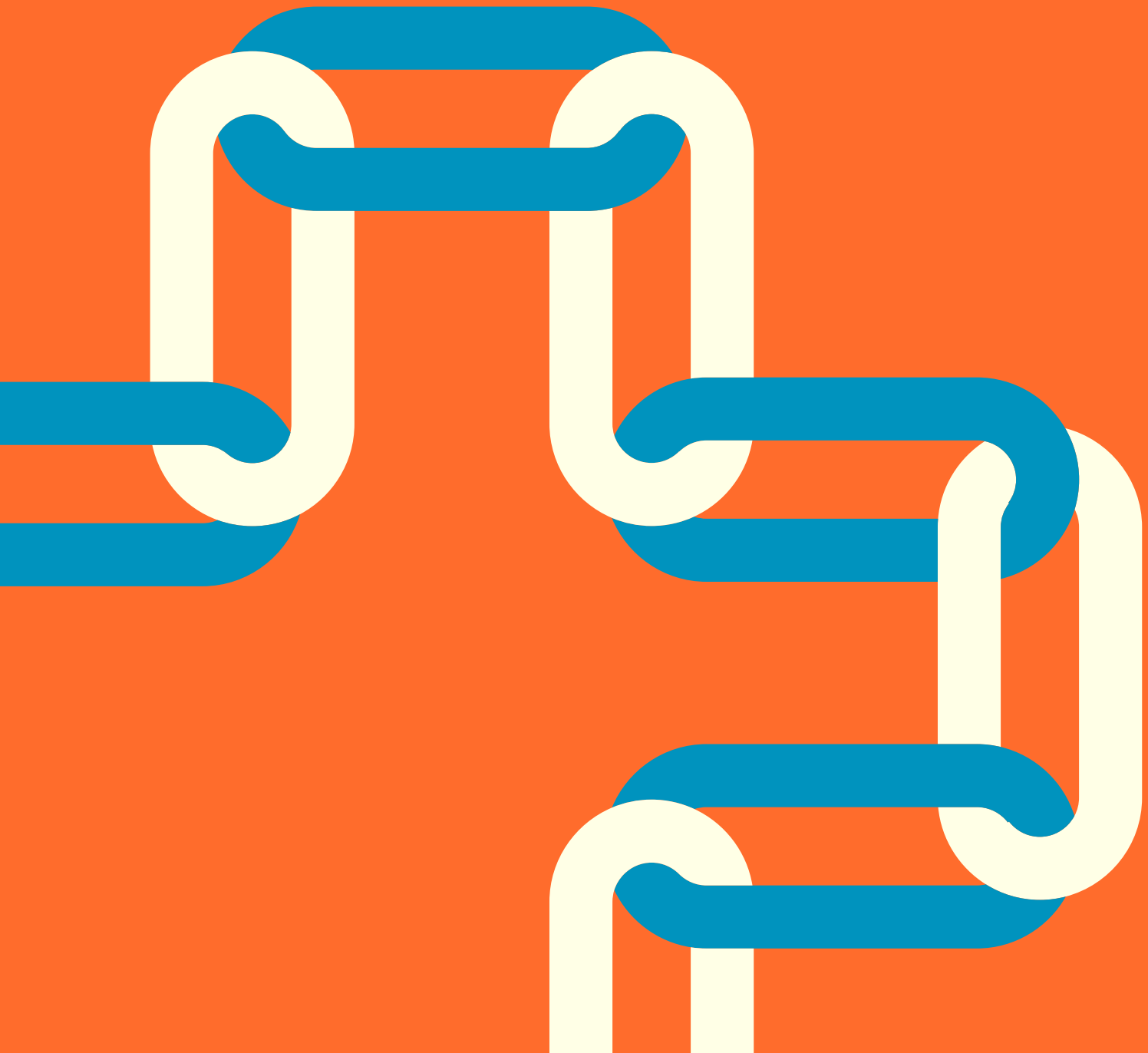

Resource efficiency is a concept that is open to a variety of interpretations, even within the resource sector. Indeed, policy makers themselves seldom define it. However, some answers can be found in the recent *Closing the loop - An EU action plan for the Circular Economy* vision from the European Commission. Here, the Commission defines resource efficiency as synonymous with the circular economy and sets targets accordingly.

When applying resource-efficient practices, companies have usually focused on conventional process optimisation strategies designed to reduce day-to-day operating costs. Wider issues such as sustainable sourcing, as well as meeting national macroeconomic objectives such as reducing the UK's dependence on raw materials and raw material imports, require active policy interventions in order to embed public policy within sustainability at company level. To truly turn businesses from linear to circular models of production and consumption, the correct policy incentives must be in place – 84% of CEOs interviewed in a recent survey (Chapter 3) called for hard intervention by governments and policymakers to support their circular and resource efficient business models.

Resource efficiency has risen up the political agenda since the mid-2000s in recognition of the challenges facing our economies as we compete on the international stage for scarce raw materials, energy and water. Economic and environmental concerns have also become increasingly aligned as our demands on nature to supply our consumption needs also results in environmental degradation that is proving difficult if not impossible to reverse.

> This is an opportune time for the UK to take the lead in progressing towards a resource efficient economy. In line with the approach taken in this collection of essays, these incentives must address the entire product lifecycle, with the active involvement of all actors in the public and private domain – central and local government, the business community, and consumers.

## Recommendations

This essay collection, structured to span the supply chain, has addressed measures that would help each stage of the supply chain deliver resource efficiency practices in a cost-effective, financially sustainable way. It has also looked at ways in which resource efficiency measures can be accurately measured and progress towards agreed targets measured. Throughout the collection, best practice examples of how businesses have successfully reduced waste and resource consumption across their supply chains have been highlighted.

This section pulls together specific recommendations to improve resource efficiency. It also highlights the importance of SMEs to the UK economy and lists them as a case for careful policy attention.

## The business case for resource efficiency – addressing the barriers

In light of the European Commission's resource efficiency roadmap and the circular economy package which contains many policy options relevant to this issue, it would be appropriate for the UK Government to commence its interaction with business by determining the state of play of resource efficiency across UK companies, and the barriers that are preventing UK companies from becoming more resource efficient.

## Recommendation 1

**Government should conduct a call for evidence on the state of play of resource efficiency in UK companies and determine the barriers that are preventing UK companies from becoming more resource efficient.**

On the strength of its call for evidence, the government should prepare a plan to remove the regulatory barriers identified.

## Procurement

Promoting the systematic adoption of Green Procurement (GP) policies will provide the UK with its single biggest 'quick win' in its transition to a resource efficient circular economy. Its power lies in the fact that GP is one of the few policy levers that influences all aspects of the circular economy, from product design to innovation in service models and management of post-consumer discards. Procurement departments both within government and UK businesses play a pivotal role in managing supply chain management as they are the gatekeepers of purchasing decisions.

Green Public Procurement (GPP) is a particularly potent policy measure promoting resource efficiency. The UK's public authorities are major consumers; in some sectors, they command a large share of the market (e.g. public transport and construction, health services and education). Furthermore, public spending also leverages additional private sector investment through PPP arrangements, which are also de facto being directed by government policy and priorities.

In relation to its circular economy package, the European Commission is fully behind GPP as a policy instrument. GPP has also been endorsed by the UK government, stating in its preliminary statement to the Latvian Presidency[97] that the Commission should explore "... the scope for public procurement, in partnership with private sector buyers, to stimulate the market for remanufactured/reused goods ... [GPP] offer[s] real potential for collective action by Member States".

On the other hand, a memorandum from the European Commission[98] states that the need for and implementation of GPP is 'better placed' within "national, regional and local authorities". In other words, the baton is passed back to the Member States.

## Recommendation 2

**Guidelines embedding resource efficient practices should be developed for UK central and local government procurement for goods and services, focusing (for example) on procurement of refurbished and remanufactured goods, or to favour recycled goods over products made from virgin raw materials.**

Government should also work with WRAP and with sectoral trade bodies to encourage resource-efficient procurement practices within the supply chains of UK businesses.

97 UK ideas for a circular economy. Defra memorandum in response to an invitation from the EU Latvian Presidency, 2015
98 CROW/C1/AF/fam ARES (2015) 5935479, 25 November 2015

## Design and manufacture

The design phase of a product is where huge environmental gains and cost savings can be made. 80% of the environmental burden and cost of a product is fixed at this stage of the supply chain.

### Recommendation 3

**Government should engage fully with the European Commission in the ongoing revision of the Ecodesign Directive, working with other Member States to incentivise more resource efficient product design, specifically around resource conservation, waste minimisation, resource recovery/reuse and remanufacturing.**

### Recommendation 4

**Government should not only continue to support remanufacturing, but extend its funding beyond the Scottish Institute of Remanufacturing to develop another focus in England along the lines of a Design and Remanufacturing Catapult centre. Fiscal incentives (such as a reduction in VAT) should also be explored.**

### Recommendation 5

**Government should develop guidelines to promote the implementation of 'Lean and Green' manufacturing standards deployed at manufacturing level, such as waste reduction, total quality management and just-in-time, to improve the company triple bottom line performance.**

## Logistics

Logistics is an essential piece of the puzzle to promote more circular practices, as it acts as a servant for other supply chain priorities, for example pricing, design and quantity. However, data is somewhat non-existent so the extent to which logistics plays a pivotal role in the story is hugely underestimated. On the inbound side, the cost of logistics is not insignificant and accounts for around 30% of the costs in food and 16% in electrical appliances, paper, textiles and automotive products to name a few broad categories of products.

### Recommendation 6

**Trade bodies should initiate a review of the inbound and outbound flows of materials and goods within their sectors, in order to identify opportunities for logistical efficiency gains (for example, minimising journeys with empty trucks).**

Where supply chains agree to introduce sector specific initiatives and improvements, Local Authority Associations should work with these industries to support them to the fullest extent possible.

## Consumer behaviour

If customers were to start demanding more resource-efficient products and services, the incentive would be in place for businesses to deliver on these demands. Most consumers would, presumably, like the products and services that they buy or rent to have a low environmental impact, but it is sometimes not easy to choose that option. There can also be difficulties for producers in delivering that option.

### Recommendation 7

**Government should work with industry across broad categories of products to develop voluntary agreements, ecolabels, and behaviour change campaigns that can encourage constant improvement and innovation in delivering resource efficient supply chains.**

## Business model innovation

Innovative business models include leasing and billing customers on the performance of a product rather than selling the product outright, are but some of the options currently being explored and trialled by the UK Government (for example, Product Service Systems) and by a number of UK businesses (for example, by Kingfisher). Not only does this necessitate a new and different relationship with the customer, but it also requires a different approach to the management of supply chain partners. Organisations that make the effort to understand the roles, relationships and respective insights of the different players across the supply chain are likely to be the ones that can successfully implement new and circular business models. If this cross-supply chain communication is effectively put in place, the task of reinventing a company's structure and business model is less daunting as the cross-supply chain support is already in place.

### Recommendation 8

**Businesses should set up communications across their supply chain to assess the key areas where improvements in resource efficiency can have the biggest impact, and put measures in place to deliver improvements in these areas. Improvements are needed in particular in the communication between manufacturers and logistics providers to ensure return of products within more circular business systems such as extended producer responsibility.**

## End-of-life discards

Huge improvements at the end of life stage of products have been made over the last decade through measures such as the landfill tax, which has resulted in a significant reduction in waste sent to landfill. As a consequence of such measures, and of waste companies being affected by commodity prices, waste companies have started to act like manufacturers. However, there is still a long way to go if the UK is to achieve zero waste to landfill in an efficient, economically viable way.

### Recommendation 9

**Government should work with local authorities to incentivise collaborations such as the Newbury Household Waste Recycling Centre (HWRc) that consists of both recycling points and donation points. These donation points are run separately but in parallel to the HWRc by organisations that refurbish and reuse donated products.**

## Metrics and targets

There are several indicators that can be used to measure resource efficiency, for example GDP/natural resource input or circulation (recycling of waste as a function of total resource input) (Chapters 3 and 10). The European Commission is currently developing indicators based on one headline indicator (GDP/Domestic Material Consumption) and several macro indicators to monitor the effectiveness of policy. The UK should be at the table during any EU discussions around resource efficiency indicators and work to ensure all member states, including the UK, take action to implement these monitoring systems.

Indicators are also needed at a company level and individual companies should set their own resource efficiency targets, for example at the most basic level, zero waste commitments.

### Recommendation 10

**Government should commence the process of establishing a comprehensive material flow framework for the UK, integrating domestic extraction, imports, recycled and reuse flows, and recyclate/product outflows. On the strength of this, raw material conservation and resource efficiency targets should be set for the UK. The option of setting a separate reuse/remanufacturing target should be assessed, in order to promote these activities.**

### Recommendation 11

**The British Standards Institution (BSI) should develop a more integrated sustainability index focussing on the whole supply chain, addressing all stages in production of products.**

## Small and medium-sized enterprises

SMEs account for over 99% of the 5.4 million registered businesses in the UK. However, roughly half of all SMEs fail after 5 years. The government needs to address therefore whether resource efficiency really is a priority for these SMEs and look to measures to reduce red tape in a manner that is not detrimental to the functionality of the sector and is careful not to create loopholes for SMEs to circumvent important waste regulations.

### Recommendation 12

**Government should support SMEs in achieving resource efficiency measures in a way that is cost-effective and deliverable. However, measures to reduce red tape for SMEs should not create loopholes for SMEs to circumvent important waste regulations.**

## Methodology

This research project was conducted between July 2015 and January 2016. Alongside individual meetings to collect evidence, a scoping roundtable was held in July 2015 to explore issues raised by the research and gather views on the structure, content and potential contributors for this essay collection. Following this roundtable, the APSRG secretariat invited selected contributors to author the essays found in this collection. The findings and policy recommendations (see Conclusion and Overview Chapter) in this report are based on the discussions from our meetings, the roundtable and content of the essays submitted.

## Scoping roundtable attendees

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## Secretariat

The All-Party Parliamentary Sustainable Resource Group is powered by Policy Connect, a not-for-profit social enterprise that works with parliamentarians, businesses and the public sector to help improve policy in the sustainability, health, education and skills, design and manufacturing sectors.

Anne-Marie Benoy
Manager
All-Party Parliamentary Sustainable Resource Group

## About the All-Party Parliamentary Sustainable Resource Group

Established in 1995, the All-Party Parliamentary Sustainable Resource Group (APSRG, part of the Policy Connect network) is the leading forum informing the debate between parliamentarians, business leaders and the sustainable resource community on the crucial policy issues affecting sustainable resource management in the UK.

Its mission is to provide an objective platform for effective communication between policy-makers, businesses and organisations with an interest in the sustainable resource management agenda and to raise awareness of sustainable resource issues within Parliament.

The Group facilitates effective, productive communication and exchange between Parliament, government, and the public, private and third sectors. To achieve this, the APSRG conducts a wide range of activities, including a programme of Parliamentary meetings, in-depth parliamentary and policy monitoring, and a research programme focusing on sustainable resource management policy.

The APSRG agenda is set by an all-party team of elected Parliamentary officers, in consultation with an expert Advisory Board, which meets twice a year to ensure that the Group is consistently at the forefront of the debate with regards to sustainable resources policy. The work is delivered by a small, dedicated secretariat which sits within Policy Connect.

The Group is supported by an Associate Membership of 58 organisations, companies and academic institutions, who, as well as providing an independent source of funding, offer a valued insight into developments occurring within the wider sustainable resource and waste management sector in the UK.

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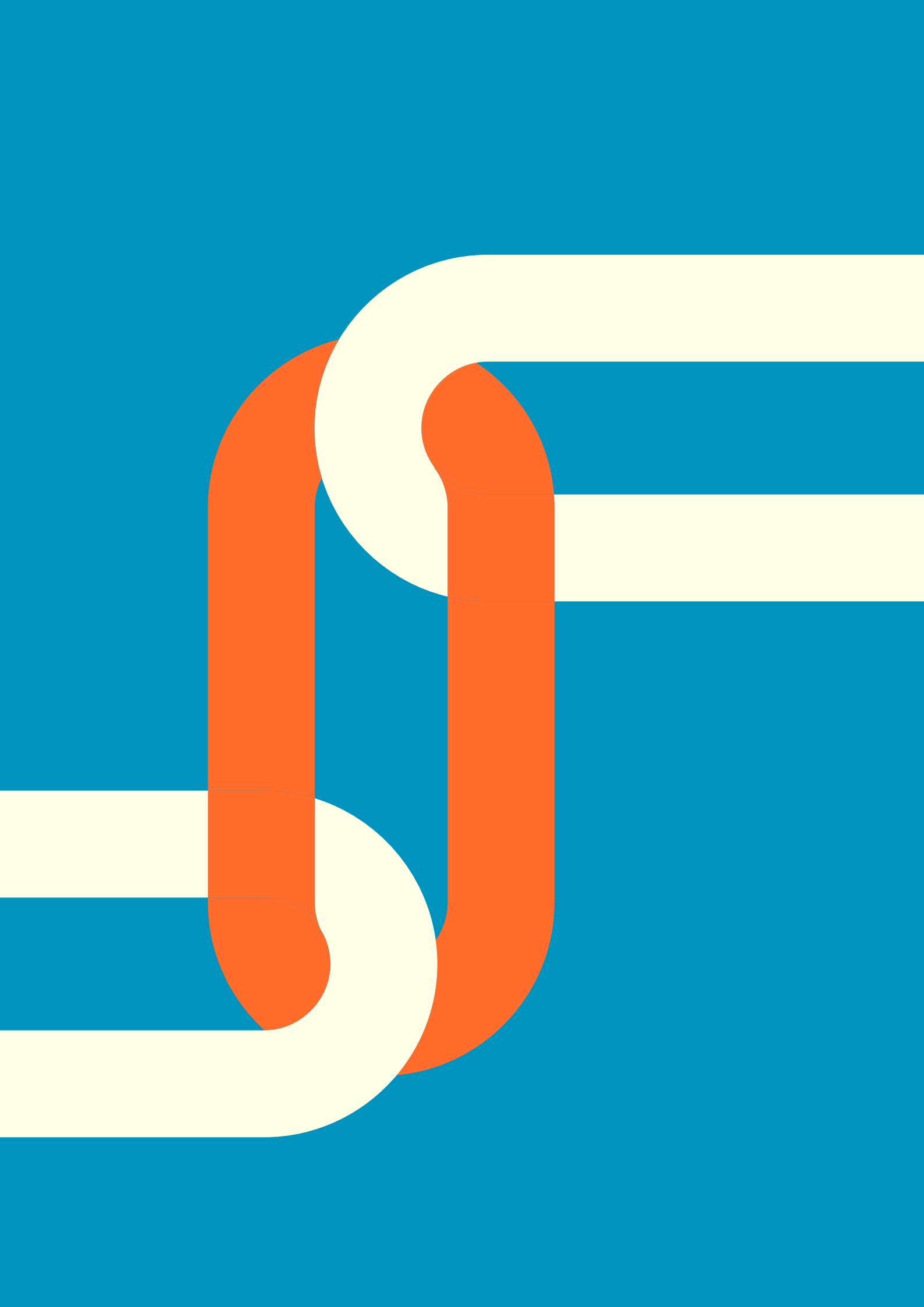

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