



LESS IS MORE

WASTE PREVENTION AND RESOURCE
OPTIMISATION ACROSS A LIFECYCLE



LESS IS MORE

A LIFECYCLE APPROACH TO WASTE PREVENTION AND RESOURCE OPTIMISATION



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"Less is more: A lifecycle approach to waste prevention and resource optimisation" was written by Laura Grant with support from the CIWEM Policy Team and the CIWEM Waste Management Panel.

Who we are, and what we do

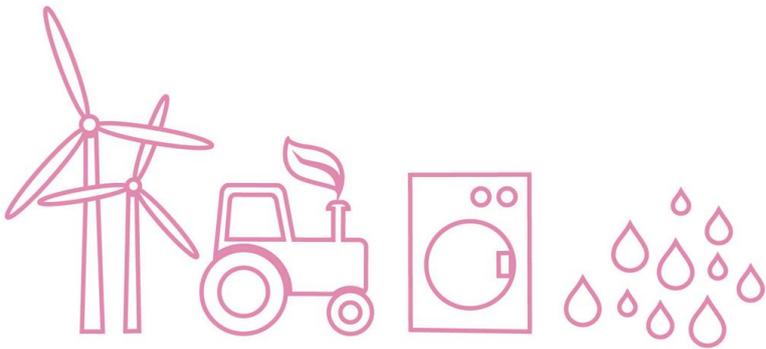
Working for the public benefit for a clean, green and sustainable world, CIWEM (The Chartered Institution of Water and Environmental Management) is the only independent, chartered professional body and registered charity with an integrated approach to environmental, social and cultural issues.

CIWEM:

- Supports thousands of members worldwide in nearly 100 countries
 - Is a powerful evidence-based lobbying force in the UK and overseas
 - Provides training and professional development opportunities
 - Provides a forum for debate through conferences, events and publications
 - Works with governments, international organisations, businesses, NGOs, the creative industries and faith groups for a holistic approach to environmental issues
 - Develops partnerships with like minded organisations across the world
 - Supplies independent advice to governments, academics, the media and the general public
 - Brings members from all over the world together under common policy issues
 - Inputs directly into European and UN policy development
 - Promotes and celebrates excellence through a varied awards portfolio
 - Is committed to improving its own environmental performance
 - Is the first chartered professional body to have its Environmental Management System accredited to ISO 14001 standard
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FOREWORD

The economic crisis of 2007 was a car crash in slow-motion; frustrating because nobody warned us and the banks danced to the speculative tune. Now economists can calculate a much more dangerous event that is being greeted with even less concern: our world is rapidly reaching a crisis in resource availability – of water, energy, metals, phosphorous and food.

The Industrial Revolution allowed us to make technological progress in delivering resources. The average price of thirty-three commodities (equally weighted) declined by 70 per cent (after inflation) between 1900 and 2002. Then, abruptly and without any particular crisis, prices reversed and in ten years the average commodity tripled to give back the advantage of the previous 100 years. It is perhaps the most important “phase” change of modern times, yet it attracted, remarkably, little attention or concern.

The causes are not hidden: there has been an explosion in population and consumption since 1800 and the birth of the ‘Hydrocarbon Age’. Global population increased from one billion to the seven billion of today, tripling even in my lifetime. At the same time, consumption of hydrocarbons and some metals increased one hundredfold.

Low-cost, high-grade coal, oil and natural gas – the backbone of the Industrial Revolution – will be a distant memory by 2050. Much higher-cost remnants will still be available but they will not be able to drive our growth, our population and, most critically, our food supply as before. Conventional food production is desperately dependant on oil for insecticide, pesticide and fertiliser, and for transportation over thousands of miles. Over the millennia, we have lost about one-third of our land, turning it into desert and stone. We build new cities on our best river valley soil, which is replaceable only with more marginal land and we build homes and grow food in deserts, pumping irreplaceable underground water. We have no New Worlds or new Midwests to turn to.

But which politician has the nerve to talk about the necessary zero growth in population and physical output? How do you persuade world leaders that 21st century problems cannot be fixed with 20th century economics? We could solve all our problems if only we were the efficient, rational human beings of standard economic theory and had politicians willing to think in the long-term interest of their people rather than their own.

It will require brave political decisions to keep our own resource prices down. We need to stop measuring success by the balance sheet and get a proper fix on our place in a world that is running on empty.



Nick Reeves OBE
Executive Director

EXECUTIVE SUMMARY

We live on a finite planet and continuing with wasteful patterns of resource use is not an option. Even the most conservative projections for global economic growth over the next decade suggest that demand for oil, coal, iron ore and other natural resources will rise by at least a third. With a rising global middle class, it will be necessary to separate the consumption of goods and services from the consumption of energy and material resources. A systematic and determined approach to resource efficiency is required, supported by a society in which management priorities are driven by where the greatest resource value can be achieved as part of a circular economy.

“The markets for critical resources have always been political”
– Chatham House

“Strong, quantifiable targets must be accompanied by consistent messaging across all parts of government that tells the world that the UK is open for green business”
– CBI

The UK economy is some way from a ‘closed loop’ economy. Around a quarter of our minerals and metals and half of our biomass is imported. A significant amount of waste is still sent to landfill, or sent abroad for treatment rather than recovered for re-use in the UK. A greater focus on resource efficiency and waste prevention in the commercial and industrial waste sectors and the anticipation of market-based, scarcity-driven price rises would improve our competitiveness and play a greater part in assisting our economic recovery, as well as making the economy more resilient.

CIWEM considers waste prevention is not an end of life resource issue and therefore needs action beyond the waste management sector. Waste prevention involves measures taken before a substance, material or product becomes a waste. As only 30 percent of our waste comes from consumers and 70 percent of materials and energy is wasted during extraction and production¹, CIWEM believes the government should use the opportunity of the waste prevention programme to look widely at resource issues. We consider a whole life-cycle approach is required with a broader look at buildings, processes and the wider issues of consumption.

“UK businesses could save more than £20bn per year by simple steps to use resources more efficiently”
– Defra

“Moving towards a circular economy could generate an additional £600 million in social value by 2020 in the UK”
– Sita

This report takes a lifecycle approach to waste prevention. We look at the stages of *demand management, design, resource extraction, manufacture, retail and distribution, use, re-use and end of life* and consider how to achieve the principles of preserving natural capital, reducing externalities and increasing efficiency for each. The various policy options that are available to the government and included in the England Waste Prevention Programme are described at each stage of the lifecycle. A variety of voluntary, fiscal and regulatory incentives are identified. We then summarise which measures would provide ‘quick wins’ and ‘big wins’.



¹ Ellen Macarthur foundation. 2012. [Towards the circular economy volume 1](#)

This report proposes that to progress waste prevention we need:

To understand that the economy is based on the environment and the materials it provides. The government's waste prevention programme for England needs to acknowledge that the efficient and environmentally responsible use of materials should be independent of whether they are raw materials, products or waste². It needs to be more pragmatic, holistic and imaginative.

Leadership and policy integration

CIWEM believes that to make the UK's economy and society one of the most resource efficient in the world we need high profile cross-government action. Defra has been leading on waste prevention policy but largely in isolation. Integration is essential if we are to achieve the estimated £20bn per year that UK businesses could save by taking simple steps to use resources more efficiently, from actions from the departments of DECC, DCLG, BIS and the Treasury. A commission-type structure or Office for Resource Management should be set up to monitor the impact of policies on resource use.

A review of incentive structures to drive sustainable behaviour

Fundamentally, our economy does not encourage sustainable behaviour, if anything it does the reverse. By not properly accounting for environmental externalities, it is hard to prevent the over-consumption and the depletion of scarce resources. CIWEM suggests using supplementary indicators to measure success other than Gross Domestic Product, changing the activities that VAT is charged upon and pricing externalities into decision making to reduce some of the drivers for mass consumption.

Extended producer responsibility to drive more measures up the hierarchy

Currently businesses have the full authority to supply products with no environmental responsibility for their impact. Responsibility has to lie with the inbound supply chain to internalise end of life externalities as part of their design, materials, logistics and marketing or progress will not be made. Most producer responsibility legislation has been aimed at designing for recycling and we need to ensure that they are used to drive material efficiency. Public funding from the EU budget needs to be prioritised to activities higher up the waste hierarchy.

To stimulate the market to cut out the least efficient products and develop new, more sustainable ones

Both businesses and the Government have a role to make the sustainable option the default choice for consumers. The Government can use various incentive structures such as minimum standards, dynamic standards, voluntary labels, procurement standards and enhanced producer responsibility. CIWEM advocates that we may also need standards for aspects of the designs of a product, materials used within them and efficiency ratings. The greatest barrier to reuse is component incompatibility so to ensure that products, components and systems retain materials within the economy over several cycles of use, requires a standardised approach for each component.

CIWEM therefore calls on the Government to take action and provide a clear, consistent framework to foster the change to a resource-efficient, circular economy.

The waste prevention strategy should not be overlooked. It is a clear opportunity to set us on a course to a resource efficient, circular economy that will not only preserve the natural environment and our supply of resources, but enable us to build a resilient and dynamic economy with strong international competitiveness. Leading companies are showing that it can be done. We now need to translate this ambition throughout the public sector to SMEs and to the wider public with a far more strategic approach, led by the Government. If England is to compete on the global stage it must be brave, ambitious and innovative enough to do things differently.

² Imperial College. 2012. Waste and resource management paper

³ Ellen Macarthur foundation. 2012. [Towards the circular economy volume 1](#)

BACKGROUND

Purpose

The stated objective of the UK governments is to move towards a 'zero waste' economy. Whilst the sentiment is welcome, CIWEM believes the concept of 'zero waste' to be unrealistic as it is difficult to define and could be counterproductive by either setting apparently unattainable goals or focussing effort at the wrong end of the supply chain. Instead, a systematic and determined approach to resource efficiency is required, supported by a society in which management priorities are driven by where the greatest resource value can be achieved as part of a circular economy.

The revised EU Waste Framework Directive requires all Member States to produce waste prevention programmes by the end of 2013. We also have to achieve EU targets to recycle, compost or reuse 50% of domestic waste and 70% of construction waste by 2020. As Scotland and Wales have already published their waste prevention strategies, **this report aims to assist in the production of England's waste prevention programme and also raise greater awareness that it is not solely an issue for the waste management industry.**

Waste prevention is key to the circular economy as it designs out waste. By looking at materials at the beginning of the production process, there is the potential to prevent waste by influencing the design, production and use stages which provides opportunities for business efficiency through the better use of processes and resources. This report shows the potential for waste prevention across material lifecycles, from extraction to disposal, in a bid to show that it is not a measure for the end-of-product-life.

By tackling waste prevention we can take a holistic approach to:

- resource efficiency – material, labour and energy savings
- resource security – protection against price volatility and imbalances in supply, protection against economic, social and geopolitical risk
- reducing environmental externalities – greenhouse gas emissions, water use, land use, energy use, embodied carbon, toxicity and amenity from less need for virgin materials
- improved national competitiveness – exporting knowledge on design and processes, anticipating scarcity driven price rises

The Global Context

For years, technological, economic and social innovation has enabled us to minimise our labour input into our industrial processes; yet this has usually required the use of more energy and more materials. To reduce our reliance on fossil fuels, it is clear that we urgently need to decarbonise the energy system and reduce our energy use; but we also need to look at our material inputs and manage materials more effectively within the economy.

All the materials, metals, minerals, concrete and wood, all the fossil fuels we burn and all the land we require to grow food and develop our economies put pressure on the environment and threaten the security of supply. In 2010, 65 billion tonnes of raw materials entered the global economic system and by 2020 this is expected to grow to about 82 billion tonnes³. Even the most conservative projections for global economic growth over the next decade suggest that demand for oil, coal, iron ore and other natural resources will rise by at least a third⁴. We live on a finite planet and continuing with wasteful patterns of resource use is not an option.

If current trends continue, by 2050, the global population is expected to have grown by 30 percent to around nine billion and people in developing and emerging economies will legitimately aspire to the consumption levels of developed countries⁵. It is expected that in the next two decades, up to three billion people will be added to the global middle class⁶ and its associated levels of affluence and consumption of heating, lighting, cooling, hygiene and food.

³ Ellen Macarthur foundation. 2012. [Towards the circular economy volume 1](#)

⁴ McKinsey Global Institute. 2011. Resource revolution: Meeting the world's energy, materials, food, and water needs

⁵ European Commission. 2011. [Roadmap to a Resource Efficient Europe](#)

⁶ McKinsey Quarterly. 2012. [Mobilizing for a resource revolution](#)

There are clear opportunities too; Defra estimates that UK businesses could save more than £20bn per year by simple steps to use resources more efficiently¹⁰ and Sita have found that moving towards a circular economy could generate an additional £600 million in social value (from community wellbeing and cohesion) by 2020 in the UK¹¹. The waste sector is in a unique position to become a major saver of greenhouse gas emissions, so waste policy also needs to be integrated with our commitment to reduce these by 80 percent by 2050 and to achieve 20 percent of our energy from renewables by 2020.

We live in an interconnected world with resources, energy and the movements of goods and in many cases pollutants all being globally connected. Hazardous waste, pollutants and greenhouse gases all harm the environment and its ability to restore itself. Yet waste and other environmental externalities are often not reflected in prices and markets and often public policies cannot fully deal with competing demands on strategic resources (such as minerals, land and water)¹².

In the UK, responsibility for waste is devolved to the governments, but European Legislation (such as the revised Waste Framework Directive, Landfill Directive, a range of "producer responsibility" directives on specific waste streams and end of life vehicles) dominates the direction of waste and resource management. Europe has become more efficient in managing material resources; but in absolute terms the consumption of materials continues to rise and the overall trend in waste generation is upwards¹³.

Waste prevention is not a new idea and has been at the top of the waste hierarchy as the most environmentally sensitive option since its conception. However, we have seen little progress and have tended to reward recycling, making it hard to think beyond it. Of the waste generated in Europe in 2010, only about 40 percent of that was reused, recycled, or composted and digested. This means that around 60 percent is lost from the system.

As only 30 percent of our waste comes from consumers and the other 70 percent of wasted materials is produced in the extraction and production phase¹⁴, CIWEM believes the Government should use the opportunity of the waste prevention programme to look widely at resource issues. We consider a whole life-cycle approach is required that takes into account energy and resource utilisation, in the manufacture of goods and products, to prevent waste by better design, improved efficiency in production and the introduction of a low waste culture.

CIWEM calls on the Government to take action and provide a clear, more central and consistent framework to foster the change to a resource-efficient, circular economy that will not only preserve the natural environment and our supply of resources, but enable us to build a resilient and dynamic economy with strong international competitiveness.

What is waste prevention?

Waste prevention has been an objective of the **EU Waste Framework Directive** ever since it was agreed in 1975 (see Annex 1 for further information). However, as it has been difficult to measure progress, terminology surrounding it can be unclear and potentially misleading. We need to understand and promote common, consistent use of the applicable terms to ensure the goals we seek are not clouded by definitions that lack clarity, are ambiguous or potentially misleading. CIWEM considers that...

Waste prevention involves measures taken before a substance, material or product becomes a waste¹⁵.

It therefore includes reuse but not recycling or home composting.

It also includes reducing the hazardousness of waste.

¹⁰ Defra. 2012. [Resource security action plan](#)

¹¹ SITA. 2012. [Creating Social Value](#)

¹² European Commission. 2011. [Roadmap to a Resource Efficient Europe](#)

¹³ European Environment Agency. 2012. [The European Environment State and Outlook, Natural resources & Waste](#)

¹⁴ Ellen Macarthur foundation. 2012. [Towards the circular economy volume 1](#)

¹⁵ European Commission. 2008. [Waste Framework Directive](#)

How is waste prevention encouraged?

The waste hierarchy is the cornerstone of waste management. The Waste Framework Directive requires that the hierarchy applies as the priority order in waste prevention and management legislation and policy. It aims to extract the maximum practical benefits from products and to generate the minimum amount of waste. The policy instruments that have been put in place to stimulate the waste hierarchy in England are shown in figure 3. To date the majority have been focussed at the base.

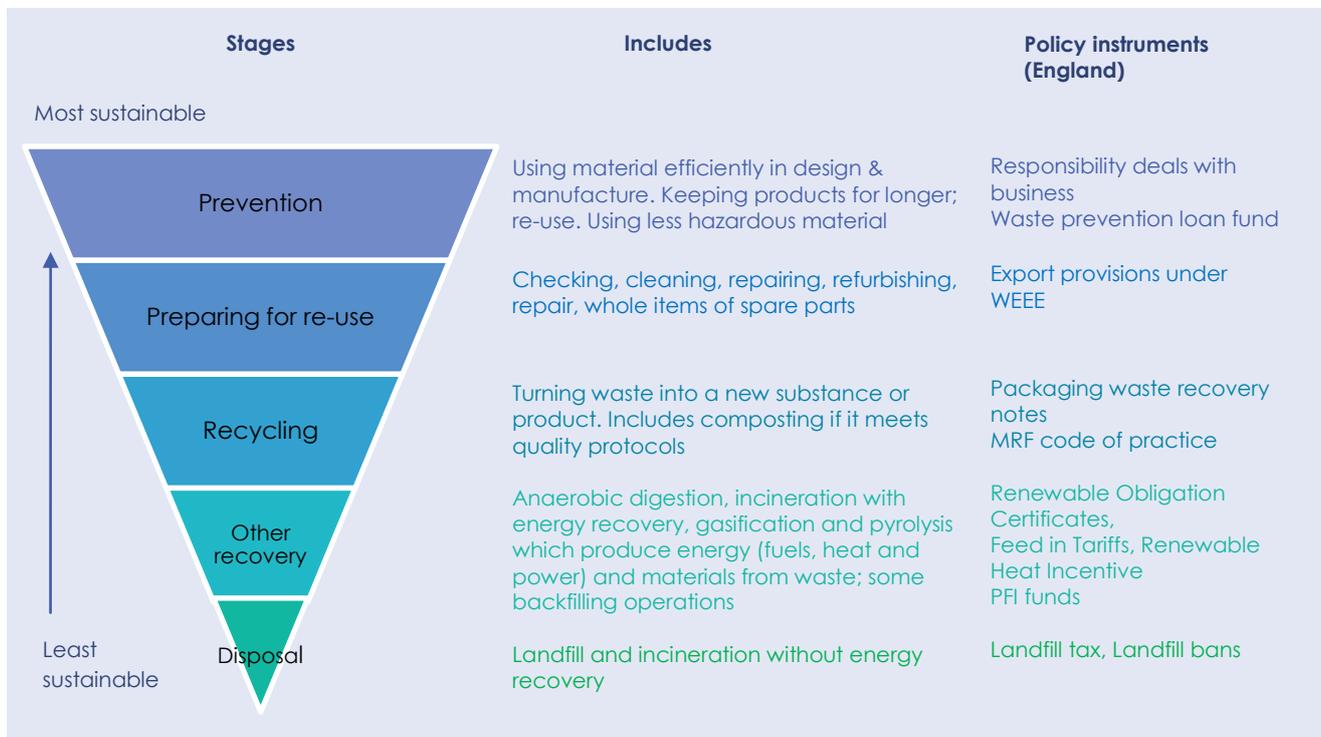


Figure 3. The Waste Hierarchy
Adapted from Defra Waste Review, 2011

Landfill tax has been a major driver and has helped halve the amount of UK waste going to landfill since 2000, but the current proportion of UK municipal waste going to landfill is still 49 percent, compared to an EU-27 average of 37 percent. There are a number of incentive mechanisms to drive recovery, but this is largely that of energy rather than materials. Defra claim that landfill tax indirectly drives waste prevention¹⁶. It may, but it does not drive measures up the hierarchy. There is a lack of real regulations or incentives tasked with driving waste minimisation and prevention at the top of the hierarchy and it is largely left to voluntary agreements. This may explain why action has stalled in the middle and recycling has become a focus of many waste minimisation and prevention strategies.

From linear to circular

Yet is the waste hierarchy still fit for purpose as ultimately it envisages a linear rather than circular economy? The challenge is how to use the hierarchy to arrive at a meaningful circular economy that balances demand, with resource and energy use to optimise the pattern of consumption.

Figure 4 shows that the UK economy is some way from a 'closed loop' economy. Around a quarter of our minerals and metals and half of our biomass is imported; the proportion of virgin materials entering the UK economy is not sustainable over time. A significant amount of waste is still sent to landfill, or sent abroad for treatment rather than recovered for re-use in the UK¹⁷.

¹⁶ Defra. 2011. [The Economics of waste and waste policy](#)

¹⁷ Defra. 2011. [Resource Security Action Plan](#)

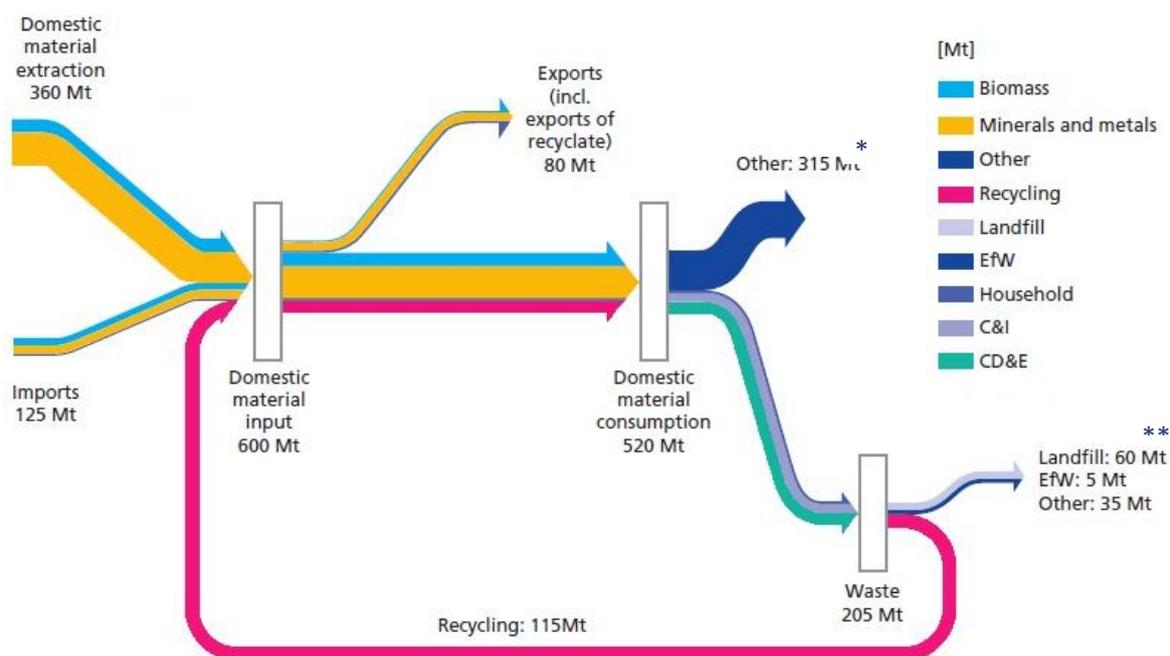


Figure 4. Estimated overview of UK Resource Flows 2009 (excluding fossil fuels)
Data from WRAP, diagram adapted from Resource Security Action Plan, Defra 2012.

NOTE:

* 'Other' outputs include food and drink consumption (estimated at 35Mt), fixed assets and dissipative outputs to land and air. Other disposal includes use on exempt sites (particularly for construction wastes, presumed to be inert). Personal and domestic consumption are not separated and more useful approach might come from Biffaward studies¹⁸ which use a Mass Balance approach of weight based data capture.

** This diagram does not highlight the inorganic minerals content currently lost to landfill.

The Government has reviewed England's waste policy in the lead up to the waste prevention programme¹⁹. However this proposed little to address the financial and regulatory discrepancy of measures within the waste hierarchy²⁰. It introduced measures to encourage recycling such as "better accessibility to recycling for businesses and consumers, responsibility deals with business sectors and introducing new packaging targets". For waste prevention, it largely fine tuned existing non-fiscal waste policies and introduced voluntary agreements including responsibility deals, funding for reward schemes and the creation of a waste prevention loan fund.

Defra itself stated that "non-pricing options, such as product standards, information policies and voluntary agreements, alone are unlikely to deliver efficient consumption and production decisions"; but have not offered any further ambition. CIWEM does not agree that these measures will be enough to meet the Review's aspirations and there should be a greater focus primarily on resource efficiency and waste prevention in the commercial and industrial waste sectors. This will help play a greater part in assisting the economic recovery and provide a range of business opportunities.

The time for action

Progress has been delayed as the European Commission was due to provide reports on the scope of waste prevention, an action plan and the set objectives and indicators to measure waste prevention by the end of 2011. There has also been a delay to the EU 7th Environmental Action Programme (2013-2020). As these reports have not emerged, it has been left to Member States to come up with their own waste prevention plans.

Wales and Scotland both published 'zero waste' strategies in 2010 (see Annex 2 for their key measures), whilst England is still in the process of determining its waste prevention strategy that should be

¹⁸ Biffa Award Mass Balance website. <http://www.massbalance.org/>

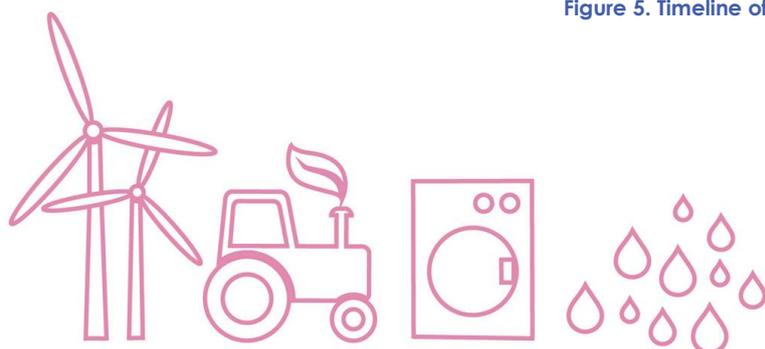
¹⁹ Defra. 2011. [Government review of waste policy in England](#)

²⁰ Environmental Services Association. 2012. [Beyond Landfill](#)

completed by the end of 2013. Although lagging behind, England at least has the opportunity to learn and draw from the initiatives already underway in devolved administrations and other EU countries and produce an outstanding policy. Figure 5 shows the progress that has been made and the targets yet to be achieved in waste prevention.

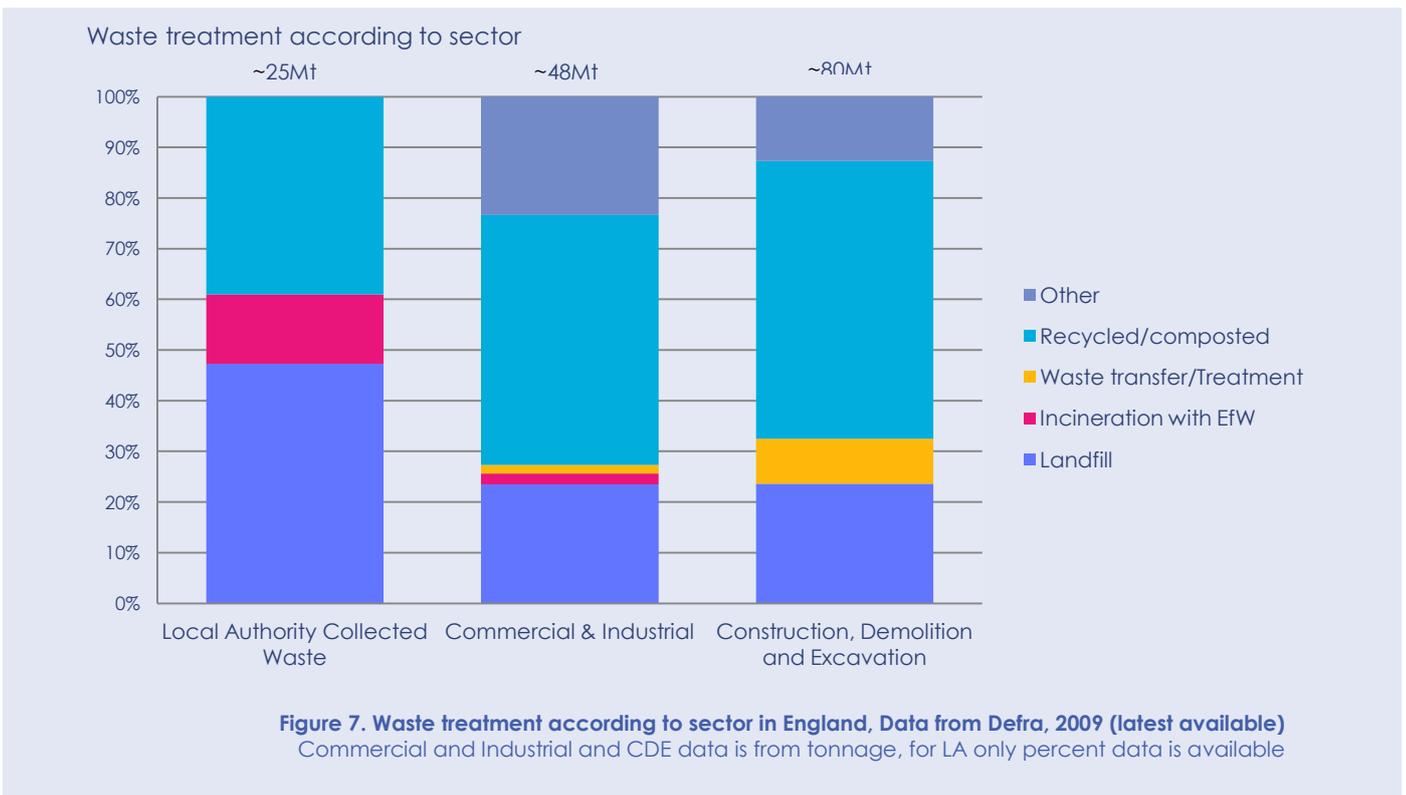
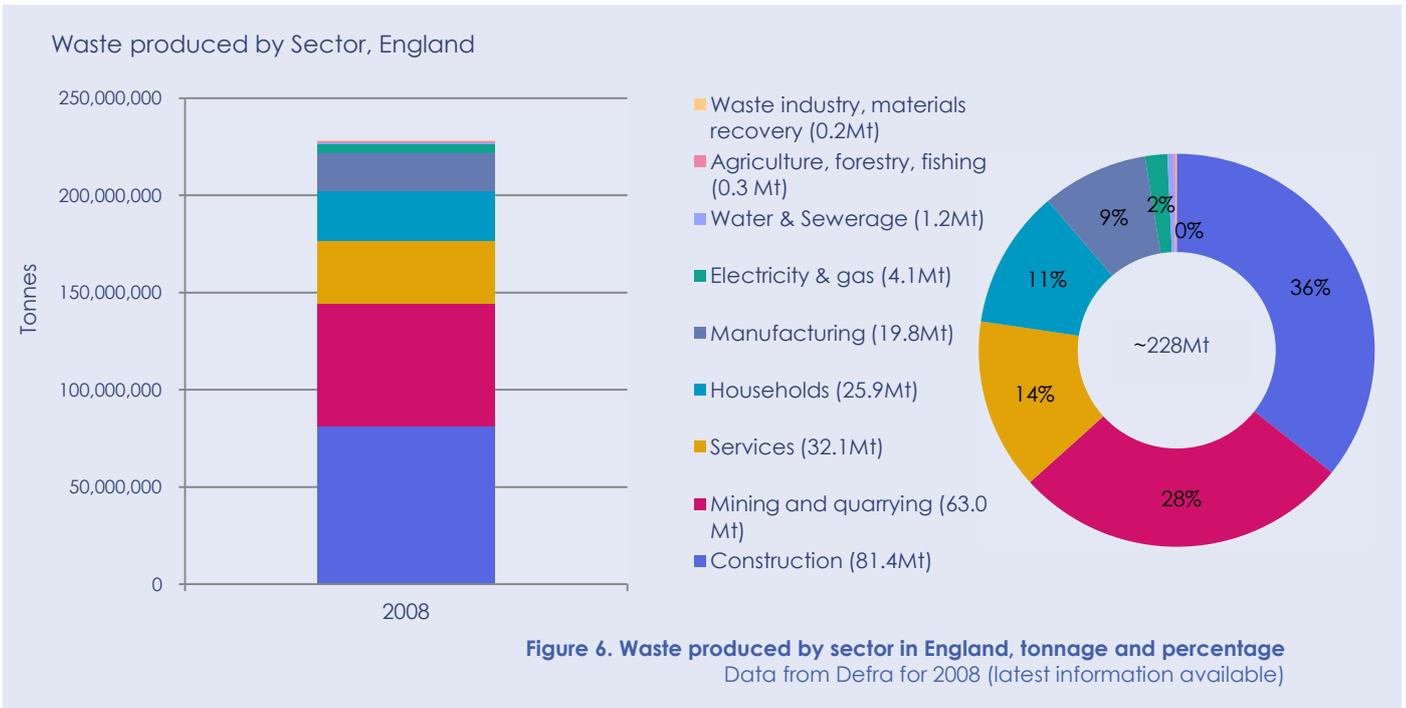
Timeline of waste prevention policies and milestones	
2008	The European Commission (EC) publish the Revised Waste Framework Directive which includes setting the waste hierarchy as a priority order in waste management, discretionary provisions on extended producer responsibility, provisions on separate collection of wastes and the need for Members to establish waste prevention programmes
2009	Defra publish a Household Waste Prevention Evidence Review , however this had a limited scope as household waste is only some 11% of total UK waste arisings
2010	Scottish Government publish Scotland's Zero Waste Plan Welsh Government publish Towards Zero Waste
2011	The Waste Regulations 2011 transpose the revised Waste Framework Directive and gave the waste hierarchy a mandatory status in England and Wales The Government Review of England's waste policy 2011 contains a commitment to work with business on a range of measures to prevent waste occurring wherever possible The European Commission publish Roadmap to a Resource Efficient Europe which sets out a vision for 2050, with milestones and key commitments
2012	EC publish Manifesto for a resource efficient Europe with a more detailed set of short term policy recommendations to address the issues due in June 2013 The EC fail to assess the introduction of minimum recycled material rates, durability and reusability criteria and extensions of producer responsibility for key products
2013	Defra to develop a full Waste Prevention Programme by December with a future programme to address products and services, the reuse infrastructure, retail solutions and product service systems Hazardous Waste National Policy Statement to be published
2014	EC to set waste prevention and decoupling objectives for 2020 EC to review existing prevention, re-use, recycling, recovery and landfill diversion targets to move towards an economy based on re-use and recycling, with residual waste close to zero. Stimulate the secondary materials market and demand for recycled materials through economic incentives and developing end-of-waste criteria
2020	EU Targets for 50% recycling for domestic waste and 70% of construction waste

Figure 5. Timeline of waste prevention policies and milestones



Where to start?

Looking for the potential to prevent waste should start with a look at where we produce waste and how it is managed. As figures 6 shows, in England around a third of our waste is from construction and demolition, a third from mining and quarrying, services make up 14 percent, with 11 percent from households and nine percent from manufacturing. According to the Waste Review, Defra's waste prevention strategy for England will focus on the key sectors of construction and demolition, food and drink, hospitality, retail, automotive and office-based services. Their choice reflects the proportions of waste produced by each sector. Mining and quarrying have not been included and this is largely because it is inert waste.



Waste is collected, treated and recorded separately according to sector (figure 7). Measures to prevent waste may be quite different for both the sectors that produce waste and those that collect and treat it.

- o Construction, demolition and excavation waste is largely separated on site, giving rise to more potential for recycling and reuse.
- o Municipal solid waste collected by local authorities poses greater problems as it includes the co-disposal of assorted waste types²¹.
- o Although smaller in volume there is a far higher proportion of household waste going to landfill rather than that produced by commercial, industrial or construction sites so there is a greater scope for prevention here.
- o Commercial waste is likely to be similar to that from households but a major issue arises with small and medium sized enterprises (SMEs) and their lack of understanding or resources to deal with waste policy.
- o Industrial waste may be more operational and/or include hazardous waste so there may be opportunities for substitution of materials and increased materials efficiency.

In compiling these data it was found that different units, time periods and methods were used by different bodies. There is a particular lack of good quality data in the commercial and industrial waste sectors²². If effective measures are to be put in place we will need a consistent approach to the collection and reporting of waste data across different bodies.

Beyond the waste management sector

The waste management industry focuses on the end-of-life stage. Yet the main opportunities to prevent waste occur before this point, from managing demand through to re-use (figure 6).

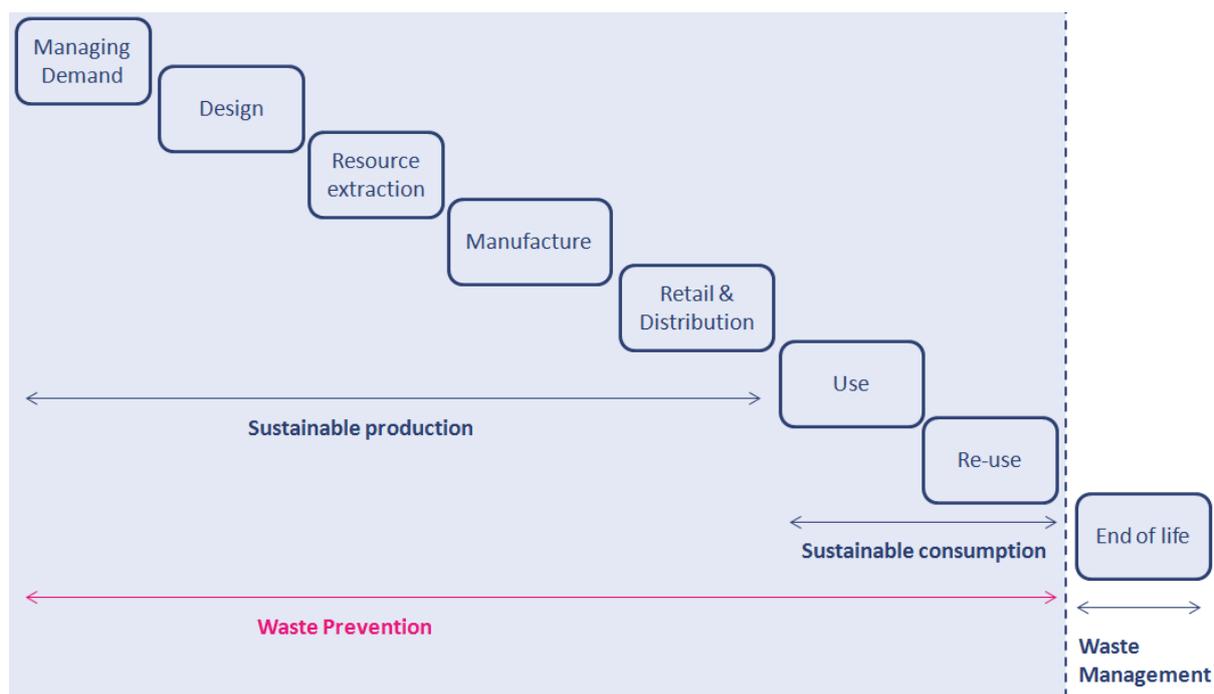


Figure 8. Types of waste minimisation and where they can be implemented across a lifecycle

CIWEM believes the Government should use the opportunity of the waste prevention programme to look widely at resource issues. Local authorities cannot continue to independently manage waste, and thus resources, with no real consideration of their wider impact. We consider a whole life-cycle approach is required to achieve more sustainable production and consumption. This will involve a

²¹ UNEP. 2012. GEO5 [Waste and chemicals chapter](#)

²² CBI. 2011. Making Ends Meet

variety of interventions involving different actors within the supply chain with the outcome of more efficient and resilient business practice, making UK plc more competitive.

Principles for waste prevention

Do not repair what is not broken, do not remanufacture something that can be repaired, do not recycle a product that can be remanufactured²³.

Preserve natural capital

- Natural resources and healthy ecosystems are essential to all life and provide the natural capital upon which humans depend. Reducing the demand for virgin materials can contribute to the preservation of natural capital and is needed to foster long-term sustainability.

Reduce externalities

- Reducing the negative impacts on the environment from pollutants to the air, water and land.
- Removing carbon from the supply chain.
- Removing substances of very high concern (SVHCs) – those that are carcinogenic, bioaccumulative, mutagenic or toxic - that have harmful impacts on human health or the environment, through the substitution of materials or chemicals²⁴.

Increase efficiency

- Energy efficiency – using less energy to provide the same services.
- Resource efficiency – a reduction in the quantity of resources employed to produce goods and services. The Technology Strategy Board defines it as “the optimal use of material resources across the lifecycle of a product.”²⁵
- Materials efficiency – reducing the total requirement for material production and processing. Distinguished from resource efficiency (where all resources are measured with a single weight measure) and from product based approaches (where it is unclear whether the improvement to a particular product has any global significance)²⁶.

The following pages outline specifically where waste prevention could be achieved at each point in the life cycle. For a given product or service there may be a different stage where the greatest potential lies. Within each stage a summary of potential policy instruments that the government may wish to consider are included and these are later summarised into a priority order. The circular economy approach tends to be applied to manufactured products, but here we take a wider look at buildings, processes and the wider issues of consumption.



²³ Stahel, W. 2010. Performance Economy.

²⁴ OECD. 2012. [Sustainable Materials Management Principles policy brief](#)

²⁵ Technology Strategy Board. 2009. Resource Efficiency Strategy 2009-12.

²⁶ Allwood JM, Ashby MF, Gutowski TG, et al. (2011) Material efficiency: A white paper. Resources, Conservation and Recycling 55: 362–381.

A LIFECYCLE APPROACH TO WASTE PREVENTION

Managing Demand

We are persuaded to spend money we don't have on things we don't need to create impressions that won't last on people we don't care about²⁷.

Clearly the best way to prevent waste is not to produce it in the first place by reducing demand. This may be quite unpalatable in a recession where we should not be seen to stifle innovation and economic growth. Market measures do risk causing distortions, unintended consequences and may even be challengeable as anticompetitive under EU or global trade rules. But reducing demand needn't threaten the economy; job creation in service industries and repair could offset job losses from declining production. The creation of a real circular economy that balances demand with resource and energy use to optimise the pattern of consumption begins with taking a look at how we use products and services (see box 1).

It is not a new idea that you may not need to own a drill to make a hole. The drill is the service that provides the hole you are after. Therefore is there a need for everyone to own a drill? The retailer B&Q is rethinking its whole business model and examining several options including shifting from selling products to leasing them. Leasing products rather than selling them has also been undertaken by companies for products such as cars, phones, electricals, tyres and carpets and has not threatened their competitiveness.

Box 1

The move to leasing goods rather than selling them has been largely driven by innovative business first movers. However Interface, (who sell the service of a floor covering rather than the product of a carpet) changed its business model after 21 years, showing that existing companies can partake in the circular economy. There is certainly more scope for UK plc to diversify, just as B&Q is doing.

The government needs to look at rebalancing economic levers.

- A circular economy is reliant on labour for remanufacture and less reliant on material extraction. Taxing the consumption of non-renewable materials instead of labour would promote the local reuse of goods and components and reinforce the competitiveness of the business models of the circular economy²⁸.
- We tax consumption through VAT, yet this is not always applied to encourage the most sustainable behaviour. The obvious example of this is that VAT is only charged at five percent on energy, regardless of its carbon intensity. Another is that no VAT is payable on new construction materials, but for repairs and restoration the VAT rate is 20 percent. This is a major barrier to refurbishment and re-use and may result in additional construction and demolition waste. Overall the government's income from VAT need not be affected, just the activities it is charged upon.

Policy options

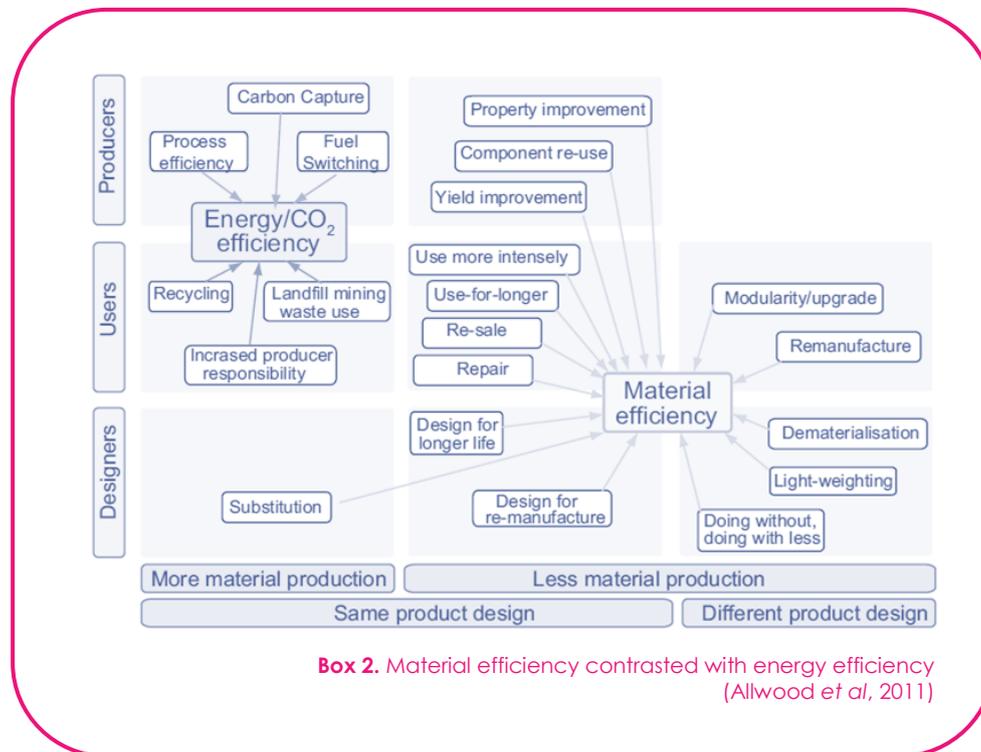
- Redressing environmental taxes to drive sustainable behaviour, especially VAT
- Encouraging leasing and sharing business models expanding the UK's service economy
- Labelling with accurate information, based on the life-cycle impacts and costs of resource use, products to help guide consumer decisions.
- Controlling marketing, such as 'buy one get one free' that encourage excessive purchasing
- Supporting and advertising car-pooling schemes
- Looking at the potential for adding a carbon tax to advertisements
- Using supplementary indicators to GDP to measure success, such as well-being indicators that would not incentivise consumption.
- Charging for service water management to incentivise sustainable drainage systems and reduce the demand for large scale drainage infrastructure, as has been achieved in Philadelphia: <http://www.phillywatersheds.org>
- Incentivising district heating to use much of the 60% of energy input to power stations that is currently not used
- Increasing education, especially in schools, on the environmental impacts and resource challenges of consumer culture

²⁷ Jackson, T. 2010. [An Economic Reality Check](#).

²⁸ Stahel, W. 2011. Point of view: Taxation. Presented to the World Resource Forum in Davos on 20 September 2011

Design

With a rising global population, it will be necessary to separate the consumption of goods and services from the consumption of energy and material resources²⁹. This is likely to require the use of industrial ecology - the application of chemical engineering thinking to the economy, analysing the flows and stocks of materials³⁰. This will call for product design that both reduces embodied materials and enables the dismantling and reuse of components. It may also involve the more intensive use of products. Box 2 shows the various options for preventing waste, either by reducing the actual quantities of material in a design or by changing the design itself.



Materials Flow Analysis is a family of tools that can be used to assess the environmental impacts of a product or service from its design to its disposal, the impacts of which may be beneficial or adverse. Whether a product needs to be made more durable or designed for a shorter lifespan with easy disassembly depends on where the most energy is used in its lifecycle.

Products where there is a great use of energy in the manufacture should be designed to be more durable, by designing for life and including parts that can be repaired. The Dyson Ltd business model encourages this and also provides more opportunity for jobs in servicing and repair. It is important to design for the product in hand; items that are prone to changes in fashion or technology may not need to be designed for as long. For example mobile phones have a design life of ten years but have an average first use of eighteen months. Another issue is that many of our products, such as old phones, come back into life via the export route in developing countries and we lose the associated resources.

In designing for a short life span (where the greatest energy use is not in the manufacture) there must be a consideration of the need to design for dismantling and remanufacture. Research has shown that for steel and aluminium, the greatest barrier to reuse is component incompatibility, i.e. different models of domestic appliances and car parts using different components (see box 3)³¹.

²⁹ Pearce, D. 1994. [Sustainable Consumption through Economic Instruments](#). Government of Norway Symposium on Sustainable Consumption, Oslo.

³⁰ Cliff, R and Allwood J. 2011. JCE v837.

³¹ Cooper D.R., Allwood, J.M. 2012. [Reusing Aluminium and Steel Components at End of Product Life](#). *Environmental Science and Technology*

The Royal Society of Arts launched The Great Recovery³² project in 2012, looking at the role of design and upstream issues for dismantling with funding from the Technology Strategy Board of £1.25m. This is exploring feasibility studies into the re-design of products, components and systems to retain material within the economy over several cycles of use. This type of innovation support is essential to change perspectives on design.

We need to design for reuse, and this includes building design. The construction industry consumes some 30% of the earth's resources³³. Approximately one-fifth of all global steel is used to reinforce concrete (210 Mt in 2008), which also presents a major challenge for reuse, as it is difficult to recover the steel bars without damaging them³⁴. In a construction project the design phase is the most important to influence in order to reduce material inputs³⁵. The Site Waste Management Plan process should be started early in order to design out materials where possible and ensure they are reused on site or recycled. Standards such as BREEAM have high specifications for the amount of waste that a site is allowed to produce and have driven more sustainable behaviour in the construction industry.

Jaguar Land Rover is developing a new metal alloy and a closed loop recycling process which increases their use of recycled aluminium. The new alloy tolerates higher levels of impurities from previously disregarded aluminium scrap castings. Developing the closed loop recycling process also reduces transport emissions because it uses materials recycled in the UK, instead of importing castings from a German supplier. These projects, funded by the Technology Strategy Board, aim to reduce aluminium waste and develop the UK aluminium recycling infrastructure by increasing the composition of recycled aluminium used in vehicle manufacture to 75%.

Box 3

Reducing the risk of products is essential to minimise their harmful effects after use. This can be achieved through substitution, such as the replacement of solvent-based paints with water-based paints. The recasting of the RoHS Directive³⁶ will play a vital part in this by banning, placing on the EU market, new electrical and electronic equipment containing more than the agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants. It is important that BIS communicates these changes to manufacturers, authorised representatives, importers and distributors.

Businesses seeking to minimise waste may find the following tools of use:

- **WRAP Waste prevention loan fund** which supports organisations to develop innovative business models to reduce the products and resources consumed; and increasing re-use, repair and recovery capacity, for electrical, textiles and furniture.
- **Site Waste Management Plans** and the **CEEQUAL** scheme – designing out waste in construction.
- **Materials Flow Analysis** use input/output tables and other tools such as lifecycle analysis to quantify flows and stocks of materials and link these to environmental impacts.
- **Material efficiency indicators** are tools to monitor processes of de-linking or de-coupling of resource use from economic growth³⁷.
- The **Cradle to Cradle framework** addresses not only materials but also energy and water inputs.

Policy options

- Implementing a sufficiently high carbon price
- Mandating efficiency labelling on products
- Setting design codes to encourage reuse, for ease of dismantling or the specification of a minimum incorporation of renewable content (for material efficiency)
- Encouraging development of new, more sustainable products (innovation support such as the Technology Strategy Board and WRAP funds)
- Using procurement standards (BS 8903:2010) to influence resource efficiency in the supply chain
- Analysing “carbon intensity of production” vs “ease of recoverability” to identify where efforts are needed

³² Royal Society of Arts. 2013. [The Great Recovery](#)

³³ Balfour Beatty. 2011. Sustainability Report

³⁴ Cooper D.R., Allwood, J.M. 2012. [Reusing aluminium and steel components at end of product life](#). *Environmental Science and Technology*

³⁵ WRAP. 2012. [Website: Designing out waste](#)

³⁶ European Commission. 2011. Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment [Directive \(2011/65/EU\)](#)

³⁷ Sustainable Europe Research Institute. 2012. [Material efficiency indicators](#)

Resource Production/ Extraction

The extraction and processing of ores is where a large environmental impact lies (to create a tonne of primary aluminium for example releases 13 tonnes of CO₂). The energy used in refining and melting iron, steel and aluminium is responsible for ten percent of the world's CO₂ emissions³⁸.

Figure 9 shows that indirect flows, i.e. the wasted material in extraction, are as great as the levels of material that are actually incorporated into the economy. The Sustainable Europe Research Institute estimates that, each year, the manufacturing of products in OECD countries consumes over 21 billion tonnes of materials that are not physically incorporated into the products themselves³⁹. These are materials that never enter the economic system such as by-catch from fishing, overburden from mining, wood and agricultural harvesting losses, as well as soil excavation and dredged materials from construction activities. There is a moral question over the environmental impacts that occur abroad from the extraction and processing of metals and minerals that are imported by the UK. Here responsible procurement is needed to reduce our environmental footprint.

Material flows in the UK, 2010

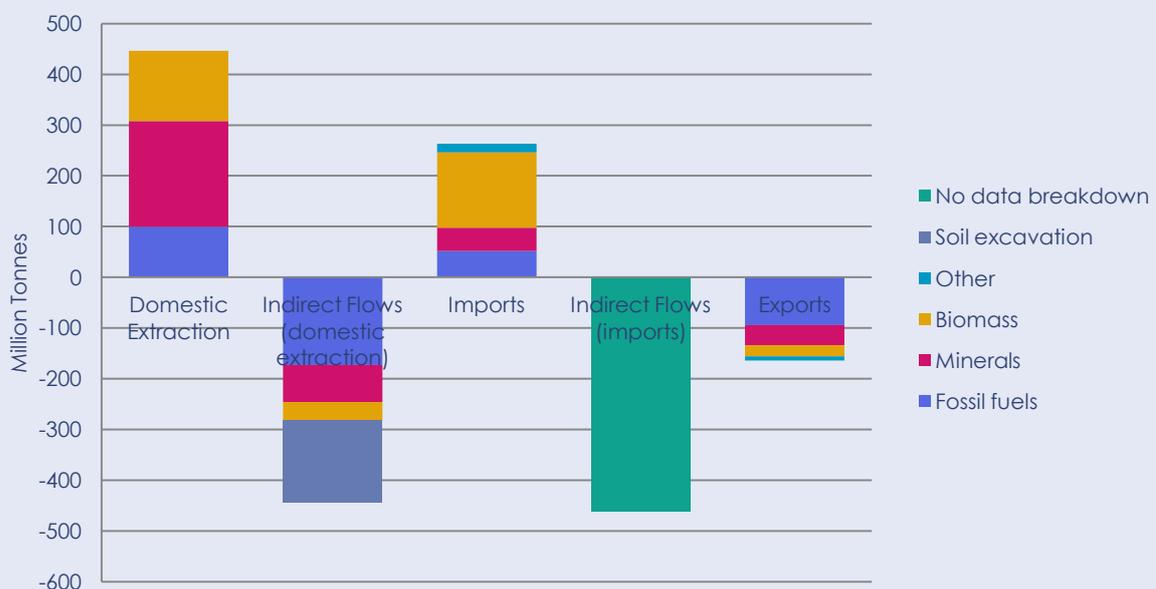


Figure 9. Material Flows in the UK, 2010
Data from ONS Environmental Accounts, 2012

Note:

Indirect flows (domestic extraction) relate to unused material which is moved during extraction, such as overburden from mining and quarrying. It does not represent the raw material use embedded in the import of manufactured products. Excludes soil erosion. Indirect flows (imports) are from the production of raw materials and semi-natural products imported into the UK⁴⁰.

Around ten percent of national energy consumption is used in the production and transportation of construction products and materials⁴¹. We need to reuse materials rather than mining virgin resources, or substitute other materials into products. With aggregates predicted as a key resource strain in the next ten years⁴², it is imperative that recycled aggregates are used in concrete. It is possible to achieve up to 90 percent recycled content in concrete and standards such as BES6001 and BS8902 can ensure responsible sourcing to meet BREEAM requirements. There is also scope for container glass and waste tyres to be used to build road surfaces or hard-standing areas; PFA (Perfluoroalkoxy) into construction blocks and compost to be used in place of peat.

³⁸ Green Alliance. 2013. [Blog: Which raw materials pose the biggest business risk](#)

³⁹ Sustainable Europe Research Institute. 2013. [materialflows.net](#)

⁴⁰ ONS. 2011. [Material Flows Methodology](#)

⁴¹ Envirowise. 2008. [Envirowise website](#)

⁴² AEA Technology plc. 2012. Review of the Future Resource Risks Faced by UK Business and an Assessment of Future Viability - A research report completed for Defra. (The study only represents an assessment at a snap shot in time)

Which resources we use is also a key consideration. A research report⁴³ completed for Defra concluded that from the perspective of supply and demand, key resources at risk and the sectors using them are:

- o Aggregates (40 years for crushed rock and 10 years for land sand and gravel) - construction and civil engineering
- o Fish – food and drink
- o Indium – electronics, IT and solar energy
- o Lithium (worldwide demand may exceed supply by 2020) – automotive and battery (hybrid and electric vehicles)
- o Phosphorus – agriculture
- o Rare earth elements – automotive, chemical, engineering and renewable energy

The point to note is that access to these resources will affect technologies that we will rely on in the future for a low carbon economy. Technologies such as electric vehicles and wind turbines require rare earth elements for high efficiency, permanent magnets. Alongside strategies for their preservation, research is needed to ascertain if there are elements that can be used or technology that can substitute these essential resources. The potential for substitution depends on the availability of material. Steel and cement dominate industrial energy demand, but in terms of performance and availability the only viable substitutes are stone and wood. Yet these two materials are considerably more difficult to use, so broadly there are no significant opportunities for substituting bulk structural materials⁴⁴.

Sports brand Puma has published Environmental Profit and Loss Accounts which values its impacts at €145 million. The supply chain is responsible for 94 percent or €137 million of its total environmental impact, with only six percent from Puma's core operations such as offices, warehouses, stores and logistics. Over half (57 percent or €83 million) of all environmental impacts are associated with the production of raw materials including leather, cotton and rubber. The analysis looked at the impacts from land use, air pollution, waste, water use and greenhouse gas emissions. These costs will serve as an initial metric for the company when aiming to mitigate the footprint of their operations and all supply chain levels.

Box 4

The Stockholm International Water Institute estimates that huge amounts of water, totalling 550 billion cubic metres, are being used to grow crops that are never eaten⁴⁵. Key efforts should be directed at reducing vegetable and crop wastes at source. At present, whole fields of crops are being rejected by major supermarkets who control 90 percent of the UK food sector, because they do not meet buyer's specifications. These 'specifications' stipulate the size, shape and skin finish of produce retailers purchase and at what price. When the cost of lifting a crop exceeds its market value there is clearly a problem with the grading system as set out in EU and DEFRA guidelines; these need to be reviewed.

Policy options

- Incentivising reuse so less virgin materials are used by pricing externalities
- Mandating extended environmental reporting for large businesses (box 4)
- Researching opportunities for substitution and sharing this knowledge
- Including the transportation of materials in Materials Flow Analysis/ Life cycle assessments
- Setting up a Government clearing house for secondary materials which links up buyers and sellers; the buyers could receive a re-use credit which is then offset against corporation tax
- Ensuring that advice and support is available to help SMEs identify and improve their resource efficiency and sustainable use of raw materials
- Extending producer responsibility directives to recover critical resources (see retail for further information)
- Setting minimum standard for responsible sourcing schemes for aggregates, pre-cast concrete and steel products in the UK - such as BES6001 and BS8902
- Reviewing grading systems in the grocery sector
- Greater use of the measure *material productivity* rather than GDP (calculated by dividing the Gross Domestic Product in real terms by Domestic Material Consumption)

⁴³ AEA Technology plc. 2012. Review of the Future Resource Risks Faced by UK Business and an Assessment of Future Viability - A research report completed for Defra. (The study only represents an assessment at a snap shot in time)

⁴⁴ Allwood, JM, Ashby MF, Gutowski, TG, Worrell E. 2013. [Material efficiency: providing material services with less material production](#). Philosophical Transactions of the Royal Society A 371 no. 1986

⁴⁵ Lundqvist J, de Fraiture C and Molden D. 2008. Saving Water: From Field to Fork – Curbing Losses and Wastage in the Food Chain. Stockholm International Water Institute Policy Brief

Manufacture

Manufacturing is an area where material and energy inputs, outputs and waste can more easily be measured. The UK's material productivity more than doubled between 1990 and 2010, as the quantity of natural resources used by the economy fell in relation to the level of economic activity⁴⁶. Though this may be unrelated to manufacturing and there is still vast scope for improvement. By improving resource efficiency, using material more effectively, using less energy and water, the government estimates that UK businesses could save around up to £23bn a year⁴⁷. Most of this (£18 bn) relates to using raw materials more efficiently in manufacturing. Realising these savings would also cut UK greenhouse gas emissions by 13 percent (90M tonnes CO₂ equivalent).

Extending knowledge through supply chains, and abroad is also essential. Large businesses can use their purchasing power to have a powerful influence over their suppliers to reduce environmental impact and influence design (box 4 shows how 94 percent of Puma's impacts are from within the supply chain). The implementation of green procurement standards (eg. BS 8903) could have a large impact on environmental externalities.

More circular use of resources is needed in the manufacturing process. The government funded National Industrial Symbiosis Programme (NISP Network) is a good example of linking businesses in the supply chain. It enables a company's waste, water, energy or a by-product to be sold to another where it may be a valuable resource⁴⁸. Co-locating industries in strategic areas would be more beneficial by utilising recovered material resources, water, heat and energy together on the same site.

The Enhanced Capital Allowances (ECA) scheme for energy-saving technologies encourages businesses to invest in energy-saving plant or machinery specified on the Energy Technology List (ETL). It allows businesses to write off the entire cost of any green technology included on the list against taxable profits. The list is managed by the Carbon Trust and has assessed over 42,000 products including boilers, lighting, refrigeration and motors.

Globally freshwater scarcity stands out as one of the most pressing cross-cutting challenges⁴⁹. Water footprinting is one technique that may ensure that water intensive industries locate in the most appropriate locations (box 5)⁵⁰. Reducing the overall water usage in the food and drink industry is currently being achieved through the voluntary agreement The Federation House Commitment⁵¹ (FHC) jointly managed by The Food and Drink Federation and WRAP. This aims to reduce water usage by 20 percent by 2020. Additional agreements could be used in other sectors.

Balfour Beatty developed a suite of water footprinting tools in 2011. Unlike carbon, water is a local issue, with its environmental impact being a function of the volume of water used and its water stress in a given area. The more stressed a locality is in terms of its water resources, the greater the impact will be. Tools were developed for their offices and projects sites, one based on the bill of materials for construction projects (embodied water) and another tool for specific products.

Box 5

Policy options

- Powering energy intensive industries with low carbon electricity
- Requiring Local Authorities to set aside areas for industrial co-location within Local Plans
- Encouraging voluntary agreements to reduce water usage and increase water reuse in manufacture and processing
- Using procurement standards (BS 8903:2010) to influence resources in the supply chain
- Exchanging information on routes to resource efficiency between partners in supply chains and across sectors, including SMEs
- Supporting further Enhanced Capital Allowances
- Shifting taxation away from labour to environmental impacts
- Using water footprinting to decide where to locate manufacturing (box 5)
- Introducing a shadow price for water, similar to that of carbon

⁴⁶ Office for National Statistics. 2012. [UK Environmental Accounts 2012](#)

⁴⁷ Defra. 2012. [Resource Security Action Plan](#)

⁴⁸ [NISP Network Website](#)

⁴⁹ World Water Assessment Programme. 2009. UN World Water Development Report 3: Water in a Changing World

⁵⁰ CIWEM. 2011. [Water Footprinting policy position statement](#)

⁵¹ [Federation House Commitment](#)

Retail and Packaging/ Distribution

Minimising the energy used in transport can be achieved by maximising the efficiency of shipments, using alternative distribution methods and the closer sourcing and linking of supply chains. The retailer IKEA uses rail for long distance transportation and flat-packing items reduces transport volume.

Over one million tonnes of mixed plastics packaging from households are disposed of in the UK each year⁵². Packaging waste is often a cause for concern among consumers but there are instances, such as food, where it is more sustainable to package the product to prevent damage, rather than throwing a damaged product away. Food, drink and packaging waste in the UK supply chain is about 6.6Mt per year and costs £5 billion. In the grocery sector the Courtauld Commitment is a voluntary responsibility deal supported by the government and delivered by WRAP, aimed at improving resource efficiency and reducing the carbon impact through the supply chain. It aims to reduce the carbon impact of grocery packaging by ten percent. It is anticipated that Courtauld 3 will be launched in 2013.

The Packaging Recovery Note (PRN) system has been the principal means through which the UK has delivered compliance with the EU Packaging Directive. It has delivered rapid improvements in the UK's recycling packaging performance with over 60 percent of packaging recycled in 2010 across the UK⁵³. However recycling is not the same as preventing waste.

Extended producer responsibility could drive more measures up the hierarchy. This is a strategy where the manufacturer of the product is made responsible for the entire life-cycle of the product which may include its repair, re-use, disassembly and recycling. This encourages more sustainable design, less toxic components and more easily recyclable parts⁵⁴.

The Ellen MacArthur Foundation has modelled the savings from keeping packaging in circulation for longer. By shifting from disposable to reusable glass bottles for beer would lower the cost of packaging, processing, and distribution by approximately 20 per cent per hundred litres. While durability would require a 34% increase in the amount of glass used per bottle, this increase in material would be small when compared to the savings that would be achieved from being able to reuse such bottles up to 30 times, as is currently achieved in Germany. A cost reduction of 20 percent (from US\$29 to \$24 per hundred litres of beer consumed) would be possible in the UK.

Box 6

Producer responsibility has been implemented through regulation for some priority materials and has been quite successful. The new WEEE Directive⁵⁵ (Waste Electrical and Electronic Equipment) introduces a collection target of 45 percent of electronic equipment sold that will apply from 2016 and, from 2019, a target of 65 percent of equipment sold, or 85 percent of electronic waste generated. It is an increasingly important waste stream to recover as it contains critical rare earth elements, gold and silver, that can be reused. Once producers are bearing the cost, financial incentives will ensure that they will find ways to design out the waste, which is true waste prevention at source.

Policy options

- Using procurement standards (BS 8903:2010) to influence resource efficiency and transportation in the supply chain
- Optimising freight transport logistics by providing information on water and rail freight options
- Enhancing producer responsibility for sectors other than automotives and electricals
- Reducing VAT on second hand or refurbished products (particularly electricals)
- Extending voluntary agreements such as Courtauld Commitment to other sectors
- Reviewing specifications for plastic packaging for recovery as not all can be easily reprocessed into polymers
- Supporting the development of smarter packaging solutions that can intelligently inform consumers when a perishable item is nearing its shelf life
- Promoting [reusable packaging suppliers](#) as listed by WRAP

⁵² WRAP. 2012. Website: [Mixed plastics packaging](#)

⁵³ Environmental Services Association. 2012. [Beyond Landfill](#)

⁵⁴ European Commission. 2008. [Waste Framework Directive 2008/98/ec](#)

⁵⁵ Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)

Use

Setting standards could drive the market to cut out the least sustainable products and influence consumers to enact and invest in more sustainable ones. Most consumers simply expect the products they buy to be sustainable. Eliminating the option to buy inferior quality products, or components with a poor environmental or social record and using forward procurement to set standards above those currently achievable can support new investment⁵⁶.

Standards for energy and water efficiency for products can drive new technologies to be developed and improve the environmental impacts during the 'use' stage. This is also true of building design meeting standards, such as the Code for Sustainable Homes and BREEAM ratings that specify levels for materials and their sourcing, insulation, daylight, natural ventilation, low carbon technologies and water use.

Many businesses are moving their data services to the 'cloud', but is this simply outsourcing the environmental impact to a service provider? New data centres are being built at ever increasing scales and with increased server density and greater energy efficiency (compared to an in-house server).

Research by Accenture shows that typical carbon emission reductions are:

- More than 90 percent for small deployments of about 100 users
- 60 to 90 percent for medium-sized deployments of about 1,000 users
- 30 to 60 percent for large deployments of about 10,000 users

Box 7. Accenture. 2010. [Cloud Computing and Sustainability](#)

The increased use of information technologies will require more efficient technologies to decrease the overall energy consumption of computation, storage and communications⁵⁷. Server virtualisation is a technology that can partition one physical server into multiple servers. Each of these virtual servers can run its own operating system and applications and perform as if it is an individual server. This makes it possible to make a saving on energy use.

With the substantial move of many organisations data storage to cloud-based systems (box 7), it will be less easy to determine where the actual servers are located. Preferred locations would be in cooler climate locations where less cooling is required and where there are large supplies of renewable energy e.g. Scandinavia. A suitable NGO could be supported by the Government to provide an accreditation of the best cloud server providers and issue them with a Government energy-efficient kite mark, just as we grade other electricals.

Almost half the food that is wasted in the UK is from within the household. The amount of household food waste generated in the UK is far higher than other European countries (137kg/capita in the UK compared to 93kg/capita in Germany and 46kg/capita in Italy)⁵⁸ showing that there is significant scope for improvement. WRAP's Love Food Hate Waste Programme encourages voluntary reductions in food waste. It was introduced in 2007 and has had some success with food waste generated by English households falling by over 1 million tonnes between 2007 and 2010. However of the food that was thrown away in 2010, 4.4 million tonnes (valued at £12 billion) were identified by WRAP as preventable through simple measures including information provision, engagement of retailers, brands, local authorities and householders and better planning. Wasted food also contributes to four percent of the UK's total water footprint⁵⁹.

Policy options

- Setting ever increasing targets for water and energy efficient products which could utilise the already voluntary labelling schemes: Energy Saving Trust, EU Energy label, Energy star
- Introducing accreditation of the most energy efficient cloud server providers
- Mandating an increasing level of Code for Sustainable Homes or BREEAM for new buildings
- Increasing water reuse in domestic and commercial settings
- Continuing education campaigns on minimising food waste e.g. from WRAP with better communication and more consistent messaging on product handling and storage for customers

⁵⁶ Sustainable Development Commission. 2007. [You are what you sell](#)

⁵⁷ Berl et al. 2010. [Energy Efficient Cloud computing](#). The Computer Journal 53 p1045-1051

⁵⁸ European Commission. 2010. Preparatory Study on Food Waste across EU 27.

⁵⁹ WRAP. 2012. [Love food hate waste](#)

End of Life

By the time the end of life stage has been reached there are no longer opportunities for waste prevention. However waste *minimisation* can still be achieved through recycling and recovery.

There is considerable scope for improvement in the logistics of the supply of goods and their end of life collection, and where these can be better joined up. The waste prevention strategy should assess opportunities for re-use hubs in cities and the potential for setting aside. Co-locating industries in strategic areas would be more beneficial by utilising recovered material resources, water, heat and energy together on the same site. This could build on the work of the National Industrial Symbiosis Programme Network.

Local consumer to consumer networks and initiatives, such as FRN, Freegle and Freecycle⁶⁰ have proven to be successful, and could be enhanced by the government advertising their existence. There is significant potential for third sector involvement in the breakdown and segregation of waste streams and the fragmentation of large contracts to localised collection and treatment. This could create more jobs through improved collection rates and end quality, as well as improved scope for community buy-in.

In planning for new collection and treatment methodologies councils must be taking decisions that are based on the holistic lifecycle of the particular material and with consideration of the linkages between collection, processing, and reprocessing⁶¹. The Government's strategy needs to look to the longer term and where markets will go. Often when we develop new technologies for waste reduction and recycling we allow as many facilities to set up as possible and this leads to oversupply and a crash in recovered value. The Government may need to set a limit on plant capacity by licensing which could be allocated on first served basis, or by auction, or by nil-value tendering. This will lift recovered material values, decrease exports and close the UK loop.

Anaerobic digestion can be used to turn organic waste into a resource and is environmentally superior to composting and recycling. Currently only 25 percent of English local authorities provide for separate collection of food waste, with a further 25 percent collecting food mixed in with garden waste. There is also greater scope for the co-digestion of sewage sludge and waste to produce biofertiliser and biogas. Regulatory barriers currently inhibit co-digestion and an update to the Quality Protocol for Anaerobic Digestate (PAS 110) needs to include provision for the use of biosolids (sewage sludge) as feedstock⁶².

A strategy for the recovery of key nutrients such as phosphate from wastewater is necessary. Phosphorus is an essential element to life. Scarcity will become a factor as demand for food increases. China has acknowledged this risk and recently imposed a 135% export tariff on phosphate rock, though the World Trade Organisation ruled against it. Defra noted that from the perspective of supply and demand, phosphorus is a key resource at risk⁶³ but this could be reduced to some extent by making phosphate recovery a legal requirement⁶⁴.

Policy options

- Using Carbon Reduction Commitment (CRC) allowances for recycling and reprocessing activities
- Joining up the supply of goods and their end of life disposal collection in hubs
- Legally requiring wastewater recovery for phosphorus
- Using Green Investment Bank funds for anaerobic digesters
- Co-digesting biodegradable waste in sewage sludge digestors to create an alternative to inorganic fertiliser
- Awareness raising on disposal of household hazardous waste
- Limiting recycling plant numbers by licensing

⁶⁰ Further details at: <http://fn.org.uk/> <http://ilovefreegle.org/> <http://www.uk.freecycle.org/>

⁶¹ National Waste and Resources Partnership Forum. Response to the LGA Local Waste Review

⁶² CIWEM. 2011. [Policy Position Statement on Co-digestion](#)

⁶³ AEA Technology plc. 2012. Review of the Future Resource Risks Faced by UK Business and an Assessment of Future Viability - A research report completed for Defra. (The study only represents an assessment at a snap shot in time)

⁶⁴ CIWEM. 2012. [Policy Position Statement on Phosphorus](#)

PRIORITY MEASURES FOR WASTE PREVENTION

Easy wins	Type of instrument
Extending producer responsibility directives to recover critical resources	Legislative / Regulatory
Setting up a cloud computing accreditation scheme	Information, subsidies and incentives
Setting minimum standards for recycled content in concrete and building materials	Certification and standards
Reducing VAT on second hand or refurbished products (particularly electricals)	Taxes and charges
Increasing education, especially in schools, on the environmental impacts and resource challenges of consumer culture.	Information
Co-digesting biodegradable waste in sewage sludge digesters	Regulatory
Big wins	Type of instrument
Legally requiring wastewater recovery for phosphorus	Regulatory/ permitting
Setting design codes to encourage reuse, for ease of dismantling or the specification of a minimum incorporation of renewable content (for material efficiency)	Certification and standards
Changing DEFRA guidelines for fruit and vegetable specifications used by food retailers, if necessary getting derogation from EU restrictions	Legislative / Regulatory
Powering industry with low carbon electricity	Subsidies and incentives
Mandating an increasing level of Code for Sustainable Homes or BREEAM for new buildings	Certification and standards
Redressing environmental taxes to drive sustainable behaviour, especially VAT	Taxes and charges
Pushing for harmonised European standards to improve recovery	Standards and certification
Implementing a sufficiently high carbon price	Taxes and charges
Ensuring that advice and support is available to help SMEs identify and improve their resource efficiency and sustainable use of raw materials	Information, research and development
Shifting taxation away from labour to environmental impacts	Taxes and charges
Incentivising district heating to use much of the 60% of energy input to power stations that is currently not used	Infrastructure

Figure 10. Priority measures for waste prevention

IMPLEMENTING WASTE PREVENTION

What will be needed?

Leadership and policy integration

The Government has a vital responsibility to lead and encourage responsible behaviour from the public sector, businesses and individuals. It has the capacity to legislate, provide incentives and support research and information sharing. As this report has shown, there has been a range of work undertaken to research and improve resource efficiency, notably by WRAP and others. Yet there still seems to be a great deal to be done to mainstream waste prevention. It is for the Government to clearly set this objective and map, strategically, how to get there.

Although a cross-cutting issue, thus far, resource efficiency has been largely left in Defra's remit. The department estimates that UK businesses could save more than £20bn per year by taking simple steps to use resources more efficiently, yet there appears to be little involvement from the departments of DECC, BIS, DCLG and the Treasury who should all be key players and such a saving represents a massive opportunity to improve the performance of UK plc. There seems to be a lack of urgency on the issue from wider government, despite its desire to develop a stronger UK economy. From the outside BIS is involved in waste prevention; however in practice their involvement appears far too limited. As recently as last month it was revealed that a chief economist at DECC had gained support from the Foreign Office, Defra and BIS for a "major review" of strains on renewable and non-renewable global resources but the Treasury had vetoed such plans⁶⁵. The more efficient management and sustainable use of materials in the economy poses a great opportunity to boost the competitiveness of UK plc but the Government, or at least the Treasury, seem blind to this.

Many manufacturers are worried about the potential impact on supply chains because of the rapid industrialisation in other parts of the globe. A survey carried out by the EEF (a manufacturing group with a quarter of UK manufacturing businesses as members) showed that access to raw materials was named as the biggest concern for industry by 80 per cent of respondents and for one in three it was their top business risk⁶⁶. Other industrialised countries are allocating funding to recover materials, such as Japan which has provided \$500m for rare earths.

Currently, large businesses rather than the government are leading the way. Following the work of the Ellen MacArthur Foundation, the *Circular Economy 100* group has been set up with the aim to bring together 100 leading companies to deliver \$10bn economic benefit from circular initiatives. The group includes large firms such as Coca-Cola, Ikea Group, M&S, Vestas, Renault, National Grid and BT. The earlier example of Puma and its *Environmental Profit and Loss Accounts* shows that it is possible to look at how commercial decisions affect environmental consequences elsewhere in the world throughout the supply chain.

"Our customers increasingly expect their infrastructure to be built and maintained using materials with minimal environmental impact over the lifecycle and to have been responsibly sourced. Being a leader in the responsible sourcing of materials helps differentiate our business in the marketplace and delivers lower cost projects by selecting recycled and alternative products in preference to primary materials" – Balfour Beatty

"Half of Unilever's raw materials come from either farms or forests. We are committed to sourcing sustainably all our agricultural raw materials by 2020. As well as protecting the planet's natural resources, sustainable sourcing helps us to manage a core business risk by ensuring security of supply for the long term." - Unilever

Both large and small companies are reliant on global supply chains so ensuring they are sustainable is a business driver. Large companies have the power to influence their supply chains through sustainable procurement, in terms of both contracts for goods and services, and can help improve the cost of a new technology and mainstream more sustainable products. They also have the resources to monitor, track and reduce their impacts. However, UK plc comprises 90% SMEs who may not have the knowledge or capacity to do this. This will require more assistance from bodies such as WRAP.

Good governance will be needed to enable innovation of our socio-economic system and create the platform for new business models such as the leasing models, service economies and industrial ecology

⁶⁵ Financial Times. 2013. Treasury kills off environment study, March 3rd 2013

⁶⁶ EEF. 2012. [Executive Survey](#)

as described previously. What this means in practice, is a strong lead from an imaginative government that takes a clear view of the whole triple bottom line. Businesses will need to be encouraged to diversify and consumers educated to understand and reduce their impacts. Local authorities will need to understand the need for the co-location of industry, designing cities for reuse and the infrastructure needed for the collection, refurbishment and distribution of products – and must be actively encouraged to do so in a strategic way. We will also need a consistent approach to the collection and reporting of waste data across different bodies if effective measures are to be put in place, perhaps a system of weight based data capture within the Office for National Statistics framework.

The range of measures presented in this report show that there are a variety of policy instruments available to the government, from voluntary agreements and information to taxes and charges. The challenge will be to find the right mix of policies along the different life-cycle phases of materials. What is clear is that policies must not be created in isolation and left in the green policy field. With resource use affecting all stages of sustainable production and consumption, integration is essential.

Many of the recommendations suggest a regulatory or legislative review, such as the co-digestion of biodegradable waste with sewage sludge and making it a legal requirement to recover phosphorus from wastewater, both of which would reduce our reliance on inorganic fertilisers. Others will require whole scale shifts of policy such as decarbonising the electricity grid and using district heating.

Defra claim they have done little to advance waste prevention “because of the often global nature of the necessary interventions”⁶⁷. Different departments within government often have conflicting policies and there is no independent body to report on these areas of conflict and ways to resolve them. A commission-type structure or Office for Resource Management could be set up to monitor the impact of policies on resource use. Another way would be for departmental business plans to each include policies and targets relating to resource use and materials management. These could then be assessed in the business plan review process that assesses sustainability of plans.

Engagement between departments when compiling targets and policies is also essential. For example waste and resource policy has the potential to save a significant amount of greenhouse gas emissions so it urgently needs to be integrated with our commitment to reduce greenhouse gas emissions by 80 percent by 2050 and to achieve 20 percent of our energy from renewables by 2020. There also needs to be more of an understanding that the economy is based on the environment and the materials it provides. At present there appears to be a great deal of ignorance by some departments to the rate of consumption and the finite nature of resources. This appears to run right to the top of Government.

By ensuring that resources are used more efficiently, we can create and protect tens of thousands of jobs, minimise environmental degradation and help revitalise the economy.

A review of incentive structures to drive sustainable behaviour

Fundamentally our economy does not encourage sustainable behaviour. Our current economic model of free markets (neo-liberal) is based on the need for year on year growth of the economy to support monetary expansion and lending. Continuous growth is not possible in a finite system. This is often exacerbated by conservative, unambitious policies which fail to recognise the interconnectedness of the economy and the environment and the cost of externalities. There are finite limits to this model as we reach environmental thresholds and population growth increases demand for energy, food, water and increased wealth and living standards.

In essence, there is a requirement to move away from economic models which are based on perpetual growth, based on consumption. Politically speaking this is an almost unimaginable challenge as such principles are the foundations of all developed, 'western' economies. Yet as the results of longitudinal studies of happiness or life satisfaction published by the Cabinet Office⁶⁸ show, levels of happiness rise with Gross Domestic Product (GDP) until basic needs are met, at which point increased GDP no longer asserts a positive effect on happiness. It is the accretion of wealth and the belief that acquisition and ownership relates to well being that needs to be challenged. A model built around sharing ownership and increasing well-being rather than material wealth would be able to support the population in a more sustainable way. Increased education, especially in schools is needed on the environmental impacts and resource challenges of consumer culture.

⁶⁷ Defra. 2011. [The Economics of Waste and Waste Policy](#)

⁶⁸ Cabinet Office. 2002. Life satisfaction: The state of knowledge and implications for government

The existence of market failures leads us as consumers to make suboptimal choices. By not properly accounting for environmental externalities, it is hard to prevent the over-consumption and the depletion of scarce resources, especially those owned in common such as unpolluted air or fish in the ocean. These market forces lead to an over production of waste. There are also market failures such as that surrounding information ownership with investors fearing they will fail to capture the return of investment on innovation because knowledge is free⁶⁹.

Using supplementary indicators to measure success other than GDP would reduce the driver for mass consumption. The European Commission proposes using resource productivity as a provisional lead indicator, measured by the ratio of GDP to Domestic Material Consumption (expressed in Euro/tonne). A higher ratio would indicate better performance, with growth consuming relatively fewer resources. This would only capture the material resources and does not deal with other resources or the potential shift of burden across countries⁷⁰.

The Government needs to look at rebalancing economic levers to drive sustainable behaviour. The present government is very anti-red tape, but with no new money available, there will need to be a careful balancing act of fiscal and regulatory measures. Some suggest we should impose more taxes on non-renewable sources of energy and materials and reduce the taxes on labour, as this is the renewable resource.

We tax consumption through VAT, yet this is not always applied to encourage the most sustainable behaviour. The obvious example of this is that VAT is only charged at five percent on energy, regardless of its carbon intensity. VAT is payable on electronic publications but not paper publications, encouraging resource use. Another is that no VAT is payable on new construction materials, but for repairs and restoration the VAT rate is 20 percent. This is a major barrier to refurbishment and re-use and may result in additional construction and demolition waste. CIWEM would also support a reduction of VAT payable on second hand or refurbished products. Overall the government's income from VAT needn't be affected, just the activities it is charged upon. Given the Government's stated aim to 'mainstream sustainability', the continued existence of such perverse incentives is a concern.

Extended producer responsibility to be used to drive more measures up the waste hierarchy

This is where the manufacturer of the product is made responsible for the entire life-cycle of the product which may include its repair, re-use, disassembly and recycling. Currently businesses have the full authority to supply products with no environmental responsibility for their impact. Responsibility has to lie with the inbound supply chain to internalise end of life externalities as part of their design, materials, logistics and marketing or progress will not be made. Eventually producers will become responsible as the cost of raw materials rises above the retrieval cost of products already in the market. We need to ensure then, that businesses are in the position to facilitate this and that the collection infrastructure is in place.

There is a need for a stable framework in which to allow for sustained investment in infrastructure. There is a lack of clear policy on waste planning and this has led to inappropriate investment in handling and treatment technologies. Public funding from the EU budget needs to be prioritised to activities higher up the waste hierarchy (for example to re-use centres over waste disposal facilities). Currently most investment is directed to energy from waste because of the potential for the Renewable Obligation, feed-in-tariffs and Renewable Heat Incentive and this conflicts with the Waste Hierarchy. A higher and stable carbon floor price could help drive measures up the hierarchy as it would account for the carbon saved further up the hierarchy and not just subsidise energy production that is not in-line with the overall carbon price. A carbon framework is needed to plan fiscal incentives and ensure that they do not cancel each other out.

It is unfortunate that the European Commission has stalled on progress as their rhetoric has been far more ambitious than that nationally. European end-of-life legislation is capable of driving materially efficient strategies. When this is complete (it is due by the end of 2014), end of life criteria should help define the course - as it is critical to know the point at which waste can legally be defined as having been recycled. This is an important driver towards the segregated collection, handling and subsequent treatment of waste. It will also be an important factor in infrastructure investment, which will create

⁶⁹ ENDS. 2013. Igniting a business revolution March 2013

⁷⁰ European Commission. 2011. [Roadmap to a Resource Efficient Europe](#)

opportunities for new companies into what is an established market. Harmonising waste policies across the EU is important to avoid 'leakage', whereby waste is exported to exploit regulatory differences.

The EC Thematic Strategy on the Prevention and Recycling of Waste, 2005 has been interpreted by several Member States as a push for recycling. This has been reinforced by a report on implementation, commissioned by the Commission⁷¹, which when analysed closely shows that the Member States that are 'compliant' (with recycling regulations) actually produce more waste per head of population than the non-compliant ones. Hence recycling has got in the way of prevention in Europe in a significant way. Most of the Producer Responsibility legislation is actually aimed at designing for recycling rather than reuse when analysed closely. Several Directives are under review and it is essential that we ensure that they are driving for material efficiency and more reuse.

Stimulating the market to cut out the least efficient products and develop new, more sustainable ones

As highlighted, this can be achieved through various incentive structures: minimum standards, dynamic standards, voluntary labels, procurement standards and enhanced producer responsibility. Both businesses and the Government have a role to make the sustainable option the default choice for consumers (figure 11).

As an illustration, the EU 'A to G' energy efficiency ratings were put in place in 1995 for white goods. This had little impact until 2001 when the Government's Energy Efficiency Commitment 1 program required electricity and gas suppliers to assist their customers to take energy-efficiency measures in their homes. This encouraged agreements between retailers and energy suppliers and moved the price of 'A' rated products into the average consumer price range (Figure 11).

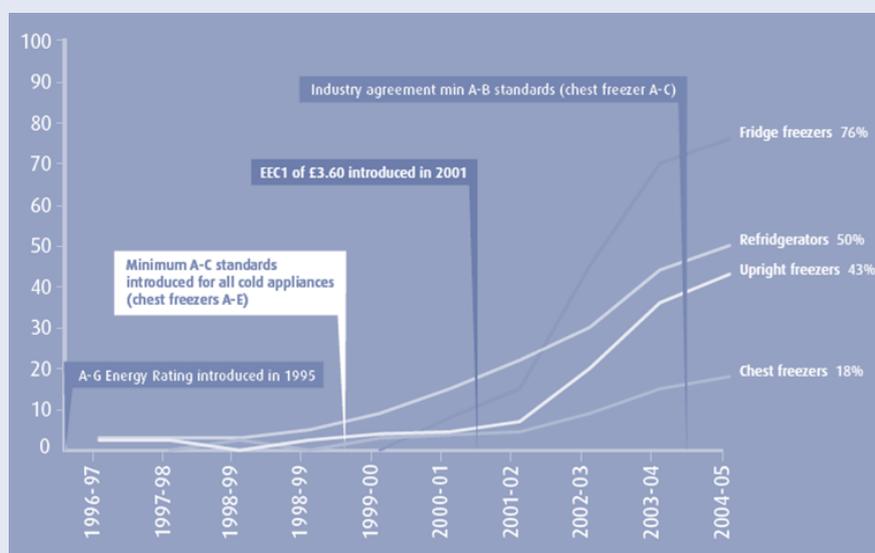


Figure 11. The effect of ratings on white goods, Sustainable Development Commission, 2007

Minimum standards work by cutting out the least sustainable or efficient products and are particularly important to initiate an industry wide change where there may be no existing market driver. In Japan, the government has taken the lead. It announces minimum efficiency standards early and then backs them with fines for any manufacturer or importer that does not conform. This has driven a virtuous circle of innovation that has improved energy efficiency of new appliances and products by as much as 78%⁷².

Dynamic standards, where they are regularly tightened, can be used to drive continuous improvements in performance such as energy or water efficiency. These work particularly well in technologies that change quickly in time such as vehicles, electricals and entertainment systems. The coherent labelling of products will also assist consumers in their purchasing choices.

The EU has already realised that transformation to a circular economy will need a policy framework where conditions are predictable and take place in a less disruptive and costly way. CIWEM advocates

⁷¹ IEEP et al. 2010. Final Report - Supporting the Thematic Strategy on Waste Prevention and Recycling.

⁷² Sustainable Development Commission. 2007. [You are what you sell.](#)

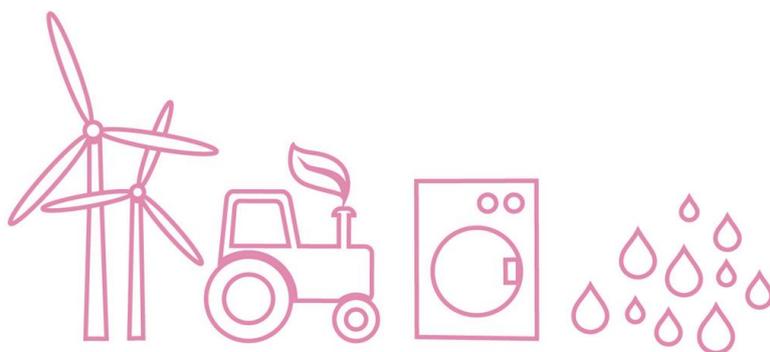
that standards are required potentially for designs of a product, materials used and efficiency ratings. These would need to be implemented at the EU level to ensure that our markets align and there is a level playing field. Setting design codes to encourage reuse, for ease of dismantling or the specification of a minimum incorporation of renewable content would increase material efficiency.

The greatest barrier to reuse is component incompatibility. To ensure that products, components and systems retain materials within the economy over several cycles of use requires a standardised approach for different components. Care would need to ensure innovation is not inhibited.

On the other hand we have to be careful that standards do not encourage waste. The fruit and vegetable specifications as set out in EU and DEFRA guidelines and used by food retailers to stipulate the size, shape and skin finish of produce is causing whole fields of crops to be rejected creating organic waste and its associated wasted water and fertiliser. There is clearly a problem with the grading system when the cost of lifting a crop exceeds its market value and this needs to be challenged by DEFRA, if necessary getting derogation from EU restrictions.

A standardised approach would improve levels of material recovery. High quality recyclates are needed within the UK for re-processing to ensure a high quality resource and maintain the potential for export. Currently the range of polymers used in packaging is seen as a barrier to recycling such that mixed plastics may in fact go for energy recovery. Coca cola has had to invest in the company ECO plastics to increase UK PET bottle recycling so it has a domestically-sourced feedstock rather than sourcing it from continental Europe.

For some materials there ought to be requirements for incorporation of recycled content, such as those that are a predicted key resource strain⁷³. With aggregates predicted to run out in the next ten years, it is imperative that recycled aggregates are used in concrete. A minimum standard for recycled content in concrete and building materials ought to be implemented to reduce our demand for virgin materials and their associated processing.



⁷³ AEA Technology plc. 2012. Review of the Future Resource Risks Faced by UK Business and an Assessment of Future Viability - A research report completed for Defra.

MAKING WASTE PREVENTION A REALITY

It is expected that in the next two decades, up to three billion people will be added to the global middle class; demand for oil, coal, iron ore and other natural resources will rise by at least a third in half that time and the environmental impacts of materials production and processing, particularly those related to energy, are rapidly becoming critical^{74,75,76}. We will reach a point where the difficulty of extracting new non-renewable resources significantly constrains our use of them and a rate at which using renewable biomass is not biologically sustainable. By acknowledging this threat, reducing demand and planning and acting strategically, **we can recover and reuse critical resources within our economy to increase our resilience in a resource constrained world.**

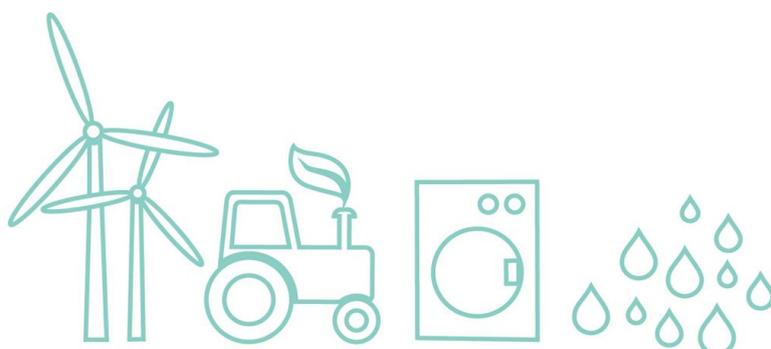
The UK governments have responded with a stated aim to move towards a 'zero waste' economy. Whilst the sentiment is welcome, CIWEM believes that the concept of 'zero waste' is unrealistic as it is difficult to define and could be counterproductive by setting apparently unattainable goals. It is also a diversion and could result in effort being focussed at the wrong end of the supply chain. Instead we need the Government to acknowledge that the economy is based on the environment and the material goods it provides and **only an integrated and systematic approach to production and consumption will reduce the total requirement for materials, energy and water.**

CIWEM advocates that taking an integrated, life-cycle approach can help to achieve the principles of waste prevention: preserving natural capital, reducing externalities and increasing efficiency across all stages in the lifecycle. By looking at materials at the beginning of the production process, there is the potential to prevent waste by design. This will involve a variety of interventions involving different actors within the supply chain with the outcome of more efficient and resilient business practice, making UK plc more competitive. **We believe management priorities should be driven by where the greatest resource value can be achieved as part of a circular economy and this relies on going beyond the waste management sector.**

The Government needs to not be afraid to ask more from business. Currently businesses have the full authority to supply products with no environmental responsibility for their impact. Leading businesses have shown that it is possible to undertake circular activities across the supply chain. The circular economy, like energy security and resource efficiency all makes clear business sense. We now need to translate and mainstream this ambition throughout the public sector to SMEs and to the wider public. If England is to compete on the global stage it must be brave, ambitious and innovative enough to do things differently. **We need a far more strategic approach, led by the Government.**

The waste prevention strategy should not be overlooked. It is a clear opportunity.

CIWEM calls on the Government to take action and provide a clear, consistent framework to foster the change to a resource-efficient, circular economy that will not only preserve the natural environment and our supply of resources, but enable us to build a resilient and dynamic economy with strong international competitiveness.



⁷⁴ McKinsey Quarterly, 2012. [Mobilizing for a resource revolution](#)

⁷⁵ McKinsey Global Institute, 2011. Resource revolution: Meeting the world's energy, materials, food & water needs

⁷⁶ OECD, 2012. Sustainable Materials Management Green Growth Policy Brief.

ANNEX 1

Waste Framework Directive (2008/98/EC) Summary

The EU Waste Framework Directive lays down measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste, and by reducing the overall impacts of, and improving the efficiency of, resource use. Revisions to the Waste Framework Directive (2008/98/EC) were adopted in December 2008 and will need to be implemented by December 2010.

The revised Directive includes requirements for member states to:

- Apply the waste hierarchy in waste management legislation and policy.
- Promote the high quality recycling of waste materials as part of the overall aim to make the EU a 'recycling society'.
- Ensure that separate collection is set up for at least the following: paper, metal, plastic and glass by 2015.
- Prepare for reuse and the recycling of waste materials such as at least paper, metal, plastic and glass from households shall be increased to a minimum of overall 50% by weight by 2020.
- Prepare for reuse, recycling and other material recovery of non-hazardous construction and demolition waste shall be increased to a minimum of 70% by weight in 2020.
- Establish an integrated and adequate network of waste disposal installations and installations for the recovery of mixed household waste.
- Ensure that waste management is carried out without endangering human health and without harming the environment.
- Establish waste management plans.
- Establish Waste Prevention Programmes describing existing prevention measures, evaluating the usefulness of other measures and determine benchmarks for measurement of adopted prevention measures.

ANNEX 2

Key measures from Scotland and Wales' waste prevention programmes

A Zero Waste Plan for Scotland

- A long term target of 70% recycling for all waste arising in Scotland by 2025
- Introduce regulatory reporting to improve data on resource use by the business sector
- Introduce progressive bans on the types of materials that may be disposed of in landfill, and associated support measures, to ensure that no resources with a value for reuse or recycling are sent to landfill by 2020
- Introduce a carbon metric for waste, to identify and prioritise the materials with the highest environmental benefit for recycling
- Introduce regulations to drive separate collection and treatment of a range of resources in order to maximise their reuse and recycling value,
- Introduce regulatory measures to support the delivery of landfill bans, by ensuring energy from waste treatment is only used to recover value from resources that cannot offer greater environmental and economic benefits through reuse or recycling.
- Review the success of measures to influence waste behaviours, including incentives, and from the results of the review, encourage the development of schemes to drive reductions in waste and improvements in recycling performance.
- Develop a tool to assist local authorities in identifying the infrastructure needed to collect, sort, recycle and recover all waste in Scotland.
- Assess existing support and resources on waste management for education providers and develop appropriate support and resources to integrate zero waste objectives into teaching and learning from early years to tertiary education in the context of Curriculum for Excellence and sustainable development education.

Wales – Towards zero waste

The Assembly Government proposes to set statutory recycling targets for municipal waste collected by local authorities. All sectors in Wales will be recycling at least 70% of their waste by 2025 - this includes businesses, households and the public sector. The construction sector will be expected to reuse and recycle 90% of its wastes by 2025. This is an intermediate step on the way to the 2050 target to achieve zero waste and live within our environmental limits.

Sector plans will:

- Consult on annual waste prevention targets of -1.2% for household waste, -1.2% for commercial waste, -1.4% for construction and demolition waste, and around -1.4% for industrial waste (in each case this will be a percentage of the 2007 baseline).
- Identify and develop markets within Wales for the recyclate and anaerobic digestion digestate.
- Identify the supply of high quality recyclate feedstock in Wales and ensure that the reprocessing infrastructure and collection systems are designed to serve the requirements of the Welsh markets as far as is practicable.
- Assess the infrastructure requirements arising from the recycling and waste management targets across all sectors, and provide mechanisms for implementing them.
- Develop mechanisms for promoting closed loop recycling facilities in Wales.
- Develop mechanisms for promoting recycling facilities that accept recyclates depending on the material they are rather than the sector they come from - to achieve economies of scale.
- Ensure capacity for residual waste treatment and the most sustainable type of residual waste treatment.
- Ensure that the waste infrastructure in Wales is as sustainable as possible, and that facilities are seen as valuable and desirable assets by the local communities that surround them.
- Food waste collected separately and managed in anaerobic digestion facilities to generate valuable renewable energy and fertiliser.
- Strong markets for recyclates and the fertiliser produced from the anaerobic digestion of food waste.

