Benefits and savings from better use of material resources and energy

A new approach to material and energy efficiency could result in annual savings of £0.8 - 8.0billion across the economy, with an additional one-off saving of £0.16 - 1.6billion. Households could save up to £2,000 each per year[1]. All this could be achieved using existing materials and without the need for any technological breakthroughs[2]. Analysis is increasingly recognising that one of the quickest ways to improve resource and energy security, whilst enhancing long-term economic growth and decarbonising the UK economy, is to reduce the consumption of materials and energy.

In some areas, quick wins might be possible through small nudges in policy frameworks. However, long-term reduction will require a policy framework based on absolute reductions in energy consumption, to avoid unintended consequences such as increased consumption as a function of cheaper cost and the off-shoring of emissions.

This paper provides a summary of the conclusions and recommendations from an expert workshop and highlights that appropriate approaches can unleash substantial savings and benefits. It identifies both quick wins and longer-term recommendations to deliver a more efficient use of materials and energy. The recommendations have implications across government departments, industry and society sectors and are intended to help inform policy development - these include:

- Shifting taxation from economic positives, such as employment, income and investment, to environmental negatives such as pollution or the use of scarce resources.
- Encouraging the light-weighting of cars which should be recognised as a priority in efforts to reduce emissions from cars.
- In the infrastructure sector, driving down over-specification and promoting more holistic material accounting.
- Raising awareness of ways to avoid food waste and reducing food packaging.
- In government procurement, setting specific targets for an absolute annual reduction in emissions across an organisation including from those embedded in the products acquired.

The views expressed do not represent the position of any particular organisation, but are intended to contribute to informed government policy making. This document presents three sector-specific opportunities and two economy-wide options. Identified by a group of industry, academic and policy experts, these represent the top five opportunities which were considered achievable and result in a net CO_2 reduction.

[1] Based on annual savings of 20 $MtCO_2$ in the built sector and 4 $MtCO_2$ one-off savings in the food sector with a marginal abatement cost of carbon ranging from £40-400 $MtCO_2$. Household savings are based on annual £700 saving from food waste for an average family and £1,300 saving from potential transport fuel efficiency improvements reducing fuel consumption.

[2] Scott & Barrett (2013)

Sector Specific Opportunities

Construction of infrastructure and commercial buildings

Between 1997 and 2011 the total material and energy use by UK construction accounted for 10% of the UK's emissions (between 40 and 61 $MtCO_2e$ per year)[3]. Infrastructure and commercial buildings account for half of this total[4]. Premature replacement rates of commercial buildings mean the lifetime of many buildings could be doubled, halving the associated emissions from steel and cement.

On average, commercial buildings in the UK are built with double the amount of steel required by the building-safety Eurocodes[5]. This over-specification occurs mainly because the sub-contract for structural design is usually placed independently of that for materials purchasing. Designers have little incentive to reduce total material purchasing, particularly if their fee is a percentage of total project cost. With steel and cement producing about 15% of the UK's energy and process-related CO_2 emissions, avoiding material overuse could have a major impact in meeting UK climate change targets and reducing demand for resources.

Mandatory material accounting could also be applied to projects covered by the UK National Infrastructure Plan (NIP), where applicable. Targets for material use by project type could be incorporated into the tendering process for the £136 billion of publicly funded projects. However, while there is considerable scope for material efficiency within the future infrastructure, the potential opportunities can be affected by existing building configurations with consequent impacts on material and energy demand. A detailed assessment of the material efficiency opportunities and future material and energy demand imposed by the NIP would be valuable.

Government sponsored initiatives have in the past proved to be very effective in realising materials and emissions reductions. For example, in the construction of the London 2012 Olympic Park, the project briefs and design processes had a strong emphasis on reducing costs and building efficient structures. This led to savings in the embodied carbon emissions ranging from 9 to 38%[6], through the efficient use of concrete, steel and other materials used in the Olympic Stadium, Aquatics Centre, Velodrome and other structures such as bridges and highways.

Driving down over-specification and adopting more holistic material accounting should be a priority. Government and commercial sector interventions to promote this could include:

- **Adjusting existing building regulations and government procurement contracts - to set the Eurocode specification standards as a minimum to be achieved not a target to be exceeded.**
- **Extending the National Infrastructure Plan to include mandatory material accounting measures for publicly funded projects.**
- **Incorporating accurate 'embodied emissions' records within certification schemes and raising their prominence with the client sector.**
- **Introducing planning and regulatory mechanisms to increase the lifetime of commercial buildings from the current replacement rate of an average of 40 years to 100+ years.**

[3] Giesekam, Barrett, Taylor, & Owen (2014)
[4] Green Construction Board (2013)
[5] Moynihan & Allwood (2012)
[6] Cullen, Carruth, Moynihan, Allwood & Epstein (2011)

Automotive Sector

Fuel consumption in cars is primarily determined by vehicle weight. However, over the last 30 years the trend has been towards bigger, heavier cars with greater acceleration and more equipment, and on average, UK cars weigh 1,350 kg (twenty times the weight of the passenger) and achieve 35-40 mpg. This has absorbed most of the efficiency gains from improved engine performance[7]. Even so, the opportunities for further improvements with existing technology are substantial, with Volkswagen about to produce a two-seater road-ready XL1 car that weighs 795 kg and achieves 313 mpg.

Initiatives to realise these substantial potential gains are underway, for example, SuperLIGHT-CAR[8] was a collaborative research and development project co-funded by the European Commission under the 6th Framework Programme. Thirty-eight leading organizations from nine European countries, including seven vehicle manufacturers, worked together to bring lightweight automotive technologies closer to high-volume car production. The project aimed to deliver the technologies and design concepts that would allow up to 30% weight reduction in the C-class range, while respecting the very demanding cost restrictions of such popular models. Furthermore, applying light-weighting to electric vehicles allows greater mileage per charge, thus potentially reducing range anxiety, a major draw-back for electric vehicle users and therefore a barrier to purchase and deployment.

Encouraging the light-weighting of cars should therefore be recognised as a priority in efforts to reduce emissions from cars. Government and industry interventions to help promote this might include:

- **Working with the EU to support regulation that promotes lightweight cars.**
- **Emphasising the inherent safety of lightweight cars in order to address the perceived safety gap between heavy and light cars.**

Food Sector

Each year around 15 Mt of food is wasted in the UK, at least 50% of which could be avoided. This comes not only from domestic and commercial waste, but also from production, processing and storage throughout the supply chain. Avoidable food waste from households alone is associated with about 3% of UK emissions (17 $MtCO_2e$ per year) and costs the average family around £700 per year.

Between 2007 and 2012, the Waste Resources and Action Programme (WRAP), a government-funded advisory body on resource efficiency, implemented interventions that helped reduce household food and drink waste by more than 1 Mt per year, avoiding an estimated 3 $MtCO_2e$ per year within the UK and a further 1.4 $MtCO_2e$ abroad. A further 7.4% reduction in waste was made in the supply chain through working directly with supermarket retailers and food manufacturers resulting in an additional reduction of 0.7 $MtCO_2e$ per year.

The reduction in food waste has been achieved through an integrated programme, which has secured support from a range of partners including the major supermarkets. Retailers and brands have supported consumer-facing campaigns (e.g. Love Food Hate Waste) and changed their packaging, labelling and in-store promotions to help consumers reduce food waste through an

[7] Knittel (2009)
[8] European Commission (2012)

internationally-recognised voluntary agreement, the Courtauld Commitment. WRAP have identified further interventions that could reduce emissions by another 3-4 $MtCO_2e$ per year by 2015[9].

Multiple economic benefits may be realised from such initiatives. Most importantly, it will make household income go further at a time when wage increases have been outstripped by inflation. Furthermore, food security is becoming ever more salient with the impacts of climate change anticipating price increases in some staples of up to 60% in the next 35 years[10].

The majority of the quick wins for resource efficiency lie in the food sector. Working with the industry, government could help deliver these through policies including:

- **Investing further in communications programmes providing information to consumers, food manufacturers and retailers/brands to help them all reduce waste further.**
- **Supporting innovation in food product design, packaging, labelling and logistics to reduce resource inputs and waste from farm-to-fork.**
- **Prioritising separate food waste collections from households and business. This will help increase awareness of food waste, thereby encouraging both prevention and recycling (which can be processed through anaerobic digestion to produce renewable energy and fertiliser).**

Cross-sector opportunities

Environmental Fiscal Reform

Shifting taxation from economic positives, such as employment, income and investment, to environmental negatives such as pollution or the use of scarce resources, can give both environmental and economic benefits. Well-designed reforms can deliver environmental benefits at essentially no macroeconomic cost; indeed it is possible for the reforms to increase GDP and to increase employment[11].

The workshop proposed establishing a Fiscal Commission for a Green Economy[12], to explore the implications of a wide range of possible environmental and resource taxes[13]. This could include road use, waste, air pollution, and land taxes, and the significant reductions in labour taxes and capital taxes that these new green taxes would enable.

Government Procurement

Public procurement by central and local government[14] is associated with emissions of approximately 120 $MtCO_2e$ per year[15], of which around 70% are embodied in products. Current approaches to procurement have relied on frameworks and guidelines, such as encouraging `Green Public Procurement' principles[16] and Scope 3[17] emission-accounting, but do not provide an assessment of overall material efficiency.

[9] WRAP 2012 - Estimate based on the proposed EU target on food waste prevention
[10] IFPRI, 2013
[11] Ekins, Summerton, Thoung & Lee (2011)
[12] UCL Green Economy Policy Commission
[13] Baptist & Hepburn (2013)
[14] Excluding capital spend
[15] Wiedmann & Barrett (2011)
[16] A voluntary instrument defined by the European Commission (Comm (2008) 400)
[17] An accounting tool for evaluating emissions embodied in the supply of products, defined by the Greenhouse Gas Protocol, developed by the World Resources Institute and the World Business Council for Sustainable Development

Considering material efficiency as well as carbon emissions could be accompanied by a move from guidelines to setting specific targets for an absolute annual reduction in emissions across an organisation, which would include from procurement and the supply / use of energy[18]. This could form part of government contracts from the NHS, schools, local authorities, other delivery agencies and government departments. A target would allow each separate delivery agency to design their own approach to achieving an absolute reduction in emissions associated with all items of procurement, not just gas and electricity.

Achieving Absolute Decoupling

It is important that the energy and materials savings achieved through the above measures translate into reduced energy and materials demand rather than increased consumption through the rebound effect. This is particularly important at the national scale. There is always the danger that the benefits of efficiency measures, such as from light-weighting of products, are lost, as the financial savings they accrue lead to consumption and emissions elsewhere in the economy. Policies should be introduced with the objective of delivering an absolute reduction in energy and resource demand even as the economy continues to grow, known as absolute decoupling[19].

The potential for rebound effects emphasises the importance of combining sectoral measures to increase efficiency in energy- and material-intensive sectors with cross-economy measures that direct the financial gains from energy efficiency to less energy- and material-intensive activities with potential gains in employment.

The proposals outlined in this document are considered by the authors as relatively simple to introduce, suggesting that an absolute reduction in the use of energy and materials, with no reduction in the services they provide, is achievable. They also have the potential to deliver innovations in design and procurement. Realising them will require cross departmental co-ordination, for example, between DCLG and DECC in defining the UK implementation of the Energy Performance of Buildings Directive. Similarly, BIS, DECC and DCLG will need to work together to define effective policies to address embodied carbon in construction.

The researchers that undertake work in this area, whose material formed the basis of the expert workshop attended by industry and policy representatives, and this paper include:

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[18] Assessed through GHG Protocol Scope 1, 2 and 3
[19] UNEP (2011)

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