Less in More out

green alliance...

Using resource efficiency to cut carbon and benefit the economy

CIE-MAP
Centre for Industrial Energy, Materials and Products

Resource efficiency is the missing climate policy

The UK has led the world in cutting carbon while growing its economy. The combination of policies to support renewables and discourage coal power, past energy efficiency measures and lower than forecast consumption has put the UK on course to meet the first three legally binding carbon budgets set by the Committee on Climate Change.

The outlook is not as rosy for future carbon budgets: government projections show that UK emissions will significantly exceed the fourth and fifth carbon budgets, which cover the years from 2023 to 2032.

We show that resource efficiency, a crucial area so far overlooked by government climate policy, could make a major contribution to meeting these budgets.

To date, government climate policy has focused on the carbon emissions from vehicles and from heating and powering buildings. But how products are made and consumed has a major effect on their embodied emissions. Putting less material into products while getting more use out of them will reduce the emissions from manufacturing.

In other words, resource use, and its associated emissions, can be cut by designing products and buildings to use less material and making supply chains more efficient (putting less in). This can also be achieved by lowering demand for new products by making them longer lasting and increasing reuse and sharing (getting more out).

Research from the Centre for Industrial Energy, Materials and Products (CIEMAP) reveals that improving material use could reduce emissions by nearly 200 $MtCO_2e$ by 2032. The modelled savings all fall in the scope of domestic targets, and would mainly come during the fourth and fifth carbon budgets from five key sectors: construction, vehicles, food and drink, electronics and appliances, and clothing and textiles. Construction alone accounts for over half of the reduction.[1]

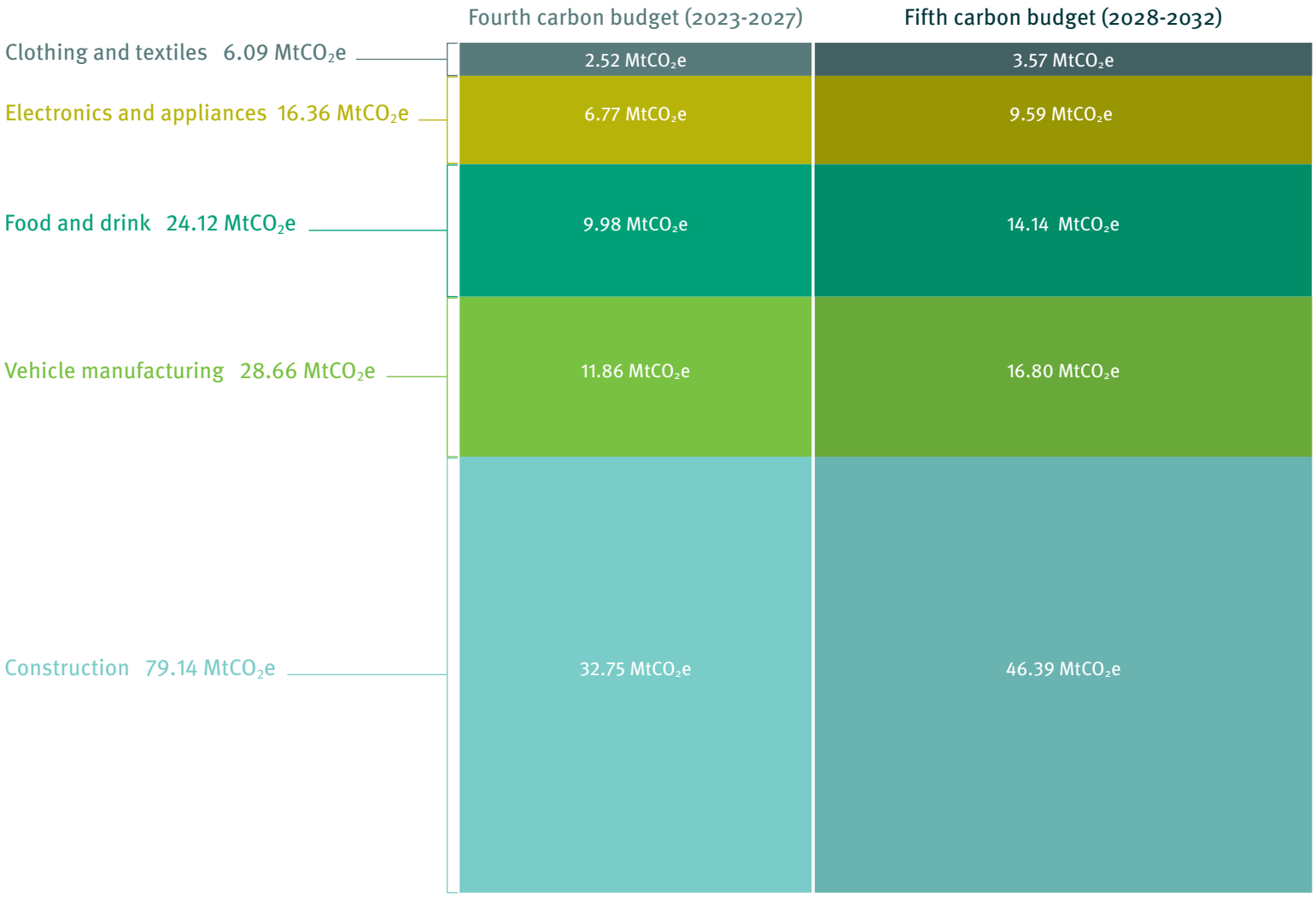
Potential carbon savings from resource efficiency measures are greater than those already achieved by many of the government's other climate policies, including the Renewable Heat Incentive, the Renewable Transport Fuel Obligation, the Carbon Reduction Commitment energy efficiency scheme and the smart meter rollout.

Using resources more efficiently is also good for the economy, improving economic competitiveness and the productivity of businesses.

Leading companies have already shown how to achieve these types of savings, but there is a huge gap between the leaders and the laggards. Each sector will also face its own challenges.

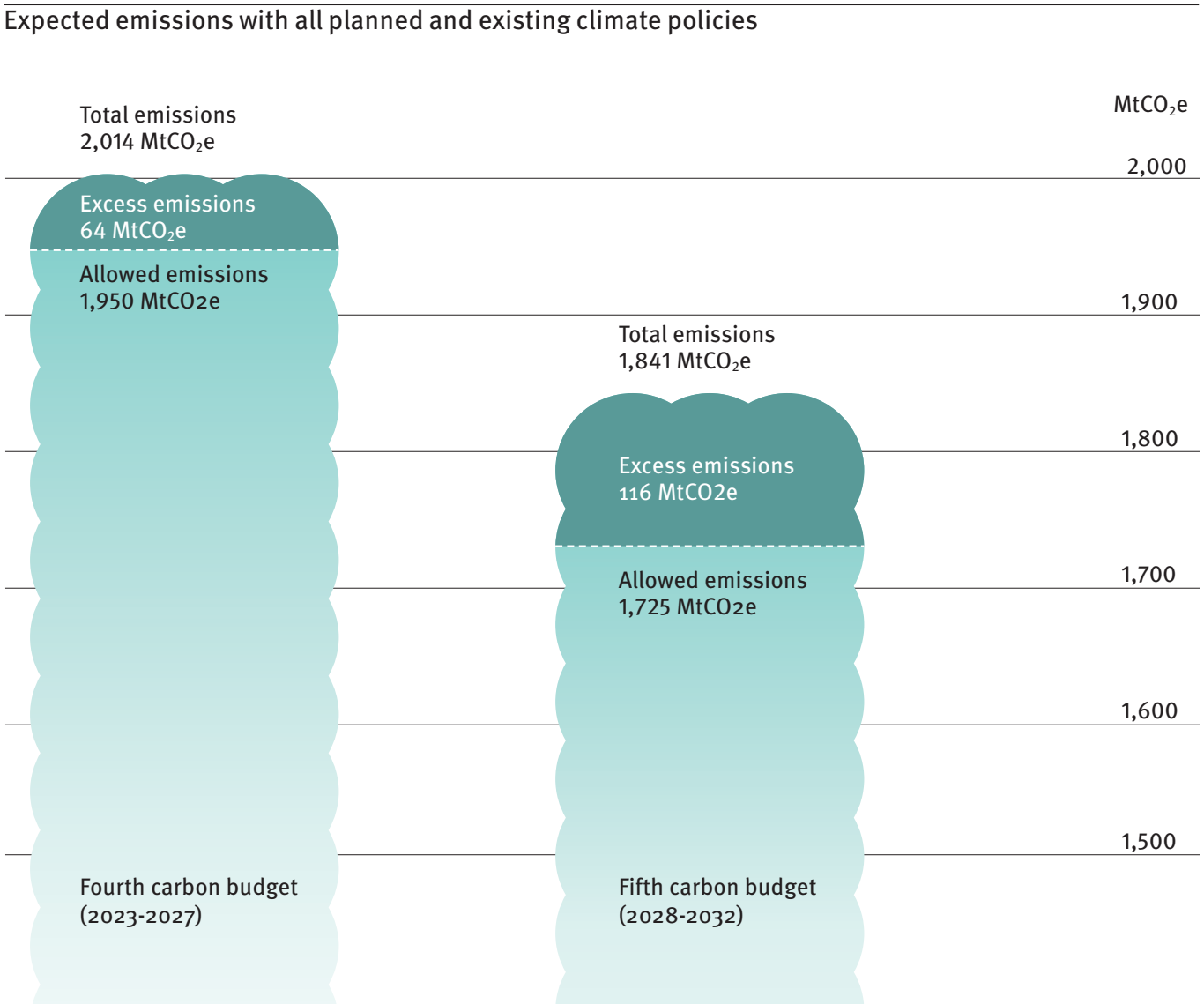
We recommend that the government sets up sector specific 'resource efficiency partnerships'. These could agree benchmarks, identify and spread innovative ways to increase resource efficiency and ensure the most is made of this major opportunity to cut UK carbon emissions.

Potential carbon savings from resource efficiency in five key sectors



The UK is not on track to meet its future carbon budgets

The UK has had some striking successes in its efforts to cut carbon emissions, with power sector emissions falling by half between 2012 and 2017. But future carbon emissions are on course to exceed the fourth and fifth carbon budgets. This overshoot is projected in spite of proposals in the government's 2017 *Clean growth strategy*, which was meant to show how the UK will meet its carbon budgets.[2]



Climate policy has ignored resource efficiency

To date, UK policy measures to reduce carbon have concentrated almost exclusively on 'operational emissions', which result from products being used. This means the focus has been on reducing vehicle tailpipe emissions or those generated by heating and powering buildings.

But resource efficiency is a significant and cost effective carbon cutting policy that has yet to be deployed by the government. Strategies to increase resource efficiency would focus on helping businesses to 'put less material in' when products and buildings were made, and 'get more out' by keeping those products and buildings in use for longer. Used together, these strategies would significantly reduce industry's carbon emissions.

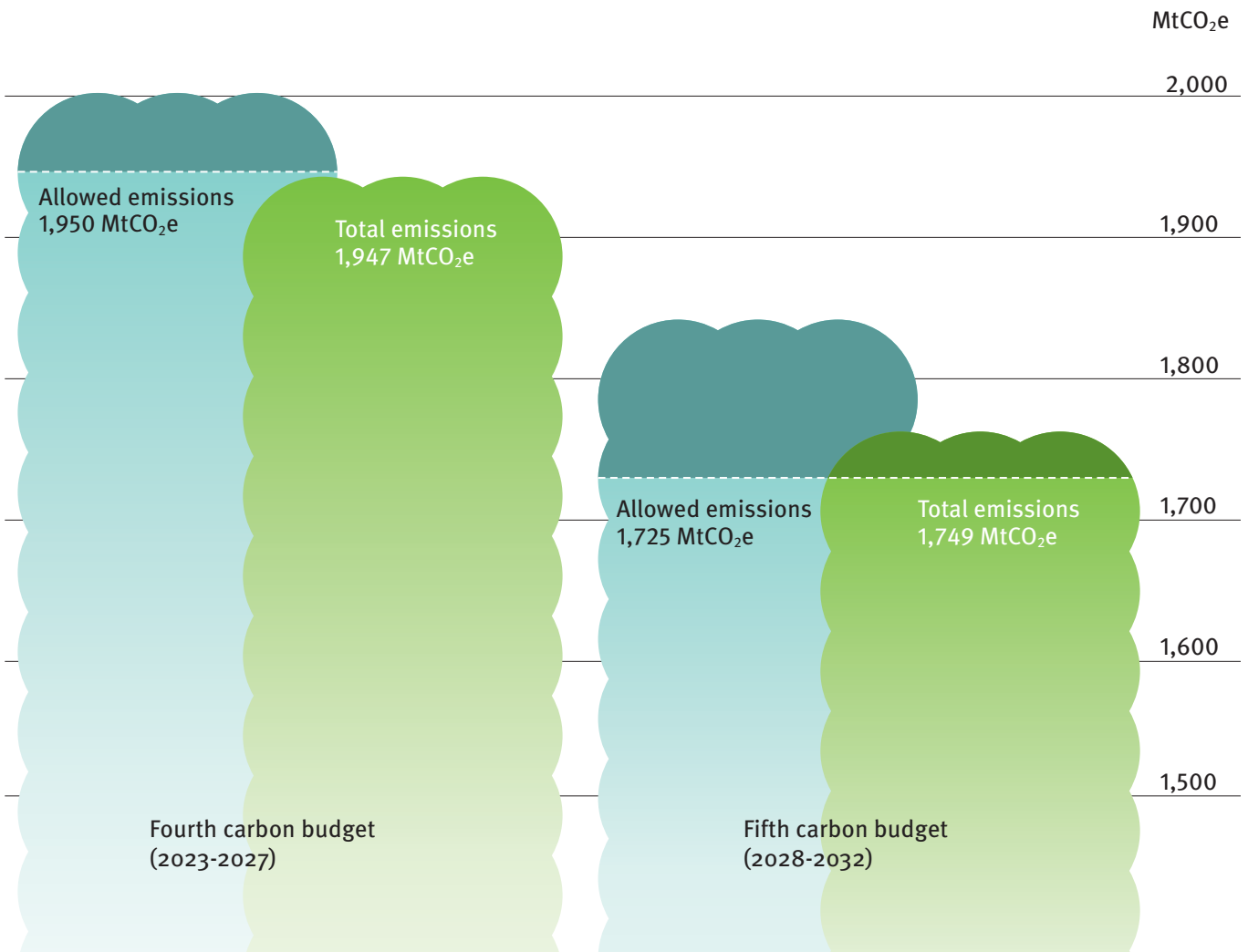
In fact, we show that improving the use of resources in the construction, vehicles, food and drink, electronics and appliances, and clothing and textiles sectors could save nearly 200 $MtCO_2e$ in the three carbon budgets to 2032. This includes 67 $MtCO_2e$ in the fourth carbon budget period and 92 $MtCO_2e$ in the fifth.

All the savings referred to in this report, modelled by CIEMAP, are from UK production and fall within the scope of domestic targets. Of course, manufactured products often have international supply chains and at least half of the emissions across the five sectors are generated outside the UK.[3] Therefore, greater resource efficiency in the UK will also result in emissions reductions in international product supply chains, in addition to those described here.

Resource efficiency would get us a step closer to meeting future budgets

A programme designed to increase resource efficiency could significantly reduce carbon emissions. In fact, if the savings we describe here were achieved, the UK would be able to meet its fourth carbon budget and reduce the expected overshoot for the fifth by nearly 80 per cent.

The potential of resource efficiency to cut carbon emissions



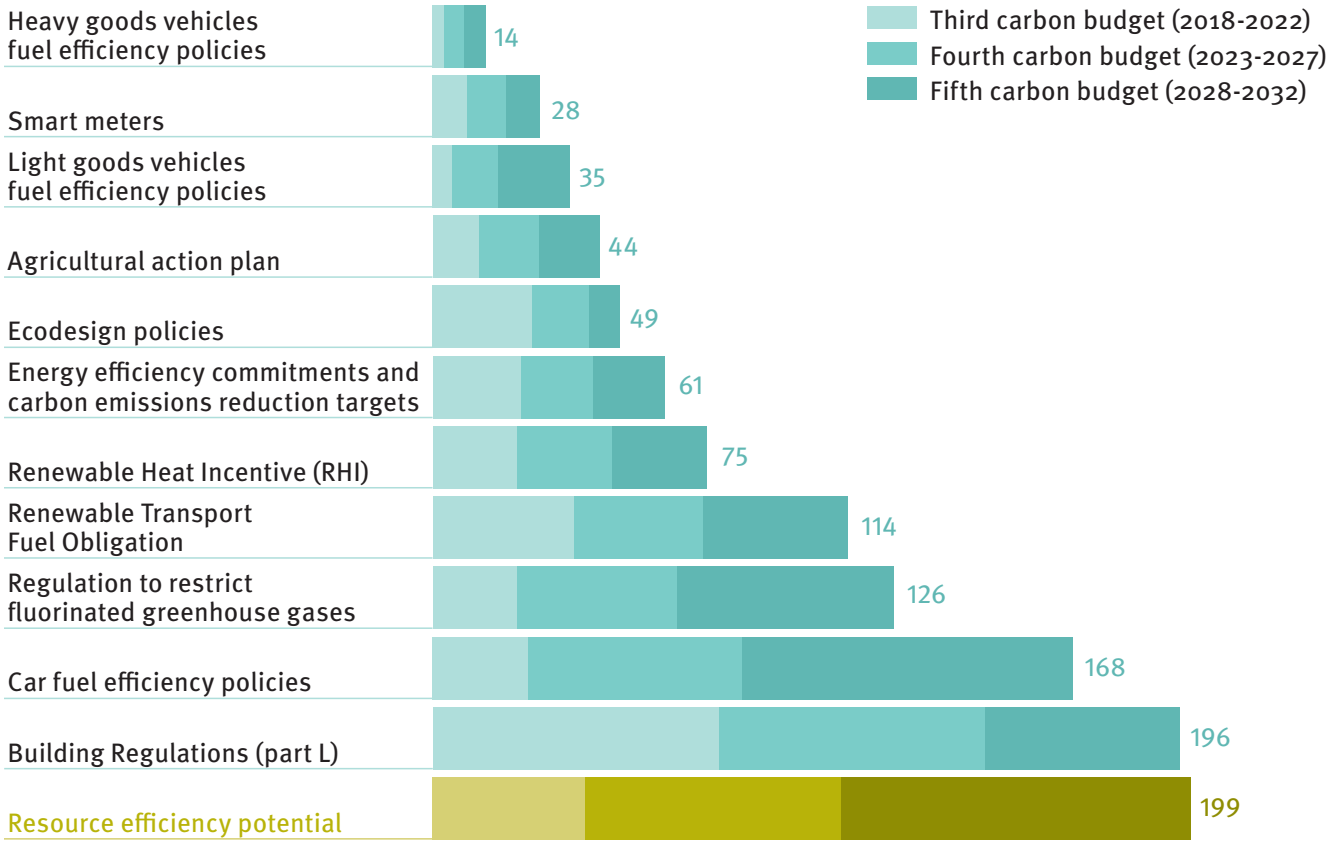
Expected emissions with existing and planned climate policies

Potential emissions with additional resource efficiency measures

It offers bigger savings than most other climate policies

The potential carbon savings from resource efficiency exceed those from many measures already implemented.

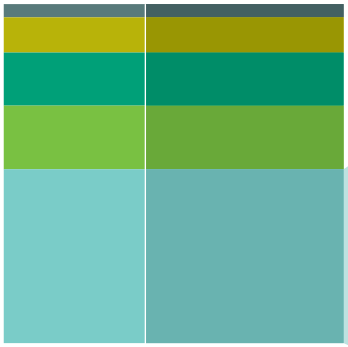
Emissions reductions from government climate policies ($MtCO_2e$)[4]



How resource efficiency can cut emissions in five key sectors

Construction

Resource efficiency in the construction sector offers the greatest opportunity to cut carbon emissions, with potential to reduce them by 79.14 $MtCO_2e$ between 2023 and 2032. This would reduce the emissions overshoot by more than half in the fourth carbon budget period and by 40 per cent in the fifth.[5]



79.14 $MtCO_2e$

Reduction in material inputs through design optimisation
8.93 $MtCO_2e$

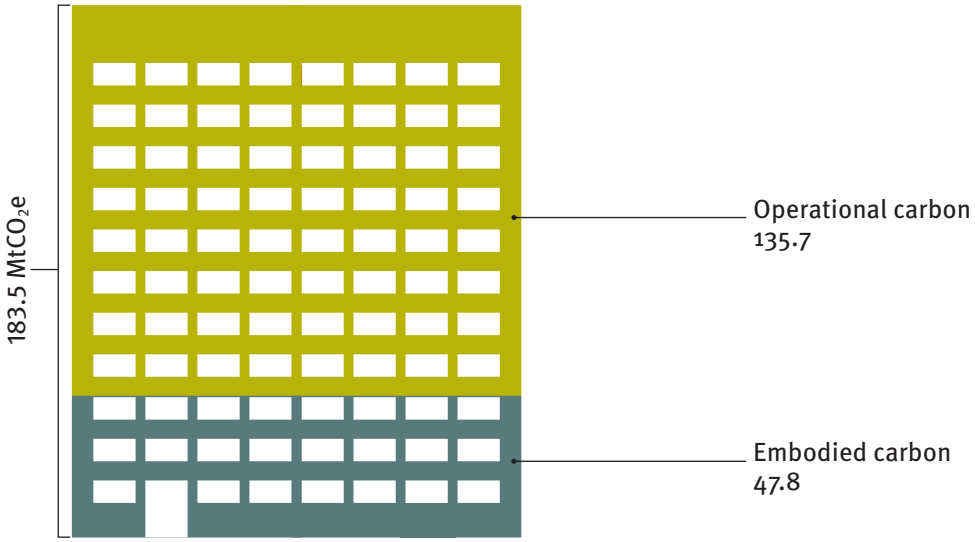
Increase reuse of construction materials
22.3 $MtCO_2e$

Substitute low carbon materials for high carbon materials
47.91 $MtCO_2e$

One strategy for the biggest impact
Substitute low carbon building materials for high carbon materials

The UK's Building Regulations are expected to reduce emissions by 250 $MtCO_2e$ by 2032, mainly by addressing 'operational carbon' from heating and powering buildings. Since 1990, the industry has achieved a 32 per cent reduction in these emissions. However, there has only been a six per cent reduction in embodied emissions (ie those associated with constructing and disposing of buildings).[6]

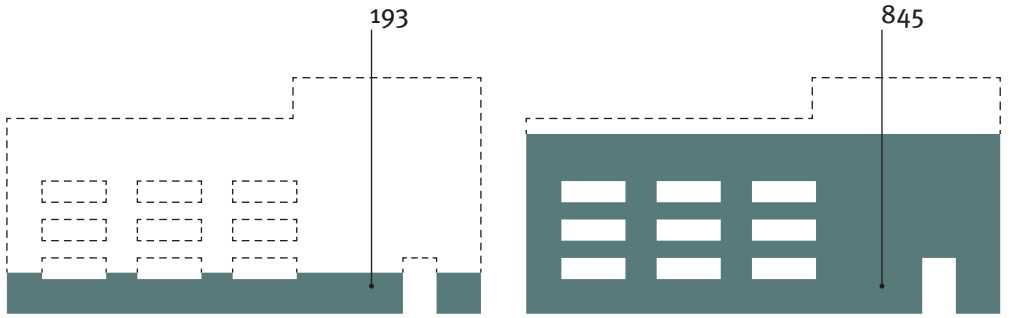
Emissions from the UK built environment in 2014 ($MtCO_2e$)



This could be improved if low carbon materials, like timber, were substituted for high carbon materials, like steel. The Enterprise Centre at the University of East Anglia, where renewable materials account for nearly half of the building by volume, shows what this approach can achieve. The use of natural and renewable materials – including timber, straw, hemp and clay – means the building's embodied carbon is only a quarter of the footprint of a typical university building.

Using lower carbon substitutes more widely in construction could cut emissions by 19.82 $MtCO_2e$ in the fourth carbon budget and 28.08 $MtCO_2e$ in the fifth.

The embodied carbon of The Enterprise Centre, University of East Anglia, compared to a typical university building ($kg/CO_2/m^2$)[7]



Vehicles

Resource efficiency in the vehicles sector could cut carbon emissions by 28.66 $MtCO_2e$ between 2023 and 2032. This would reduce the emissions overshoot by 19 per cent in the fourth budget period and 14 per cent in the fifth.[8]

28.66 $MtCO_2e$

6% increase in refurbishment of steel parts **0.91 $MtCO_2e$**

15% material savings by increasing refurbishment of used cars
4.26 $MtCO_2e$

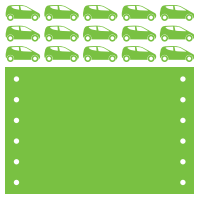
Reduce manufacturing waste of steel by 10% and other metals by 20%
5.85 $MtCO_2e$

Reduce the weight of steel, aluminium and other materials used
8.49 $MtCO_2e$

Increase the lifetime of cars by four years
9.15 $MtCO_2e$

One strategy for the biggest impact
Use cars for four more years

Steel is very emissions intensive, accounting for a quarter of global industrial carbon emissions[9]



Nearly a third of UK steel demand is for vehicles manufacturing[10]

The potential lifespan of an average car is 20 years

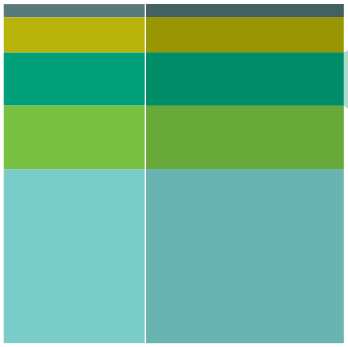
The actual lifespan of an average car in the UK is 13 years[11]

Using cars for longer, especially new models and electric vehicles, is one of the best ways to reduce carbon emissions from the vehicles sector. As with other products, the production process, including mining metals and manufacturing cars, is relatively carbon intense.

Because it would reduce the use of materials and energy for manufacturing, keeping cars in use for four more years would reduce carbon emissions by 3.79 $MtCO_2e$ in the fourth carbon budget period and 5.36 $MtCO_2e$ in the fifth.

Food and drink

Resource efficiency in the food and drink sector could cut carbon emissions by 24.12 $MtCO_2e$ between 2023 and 2032. This would reduce the emissions overshoot by 16 per cent in the fourth carbon budget and more than 12 per cent in the fifth.[12]

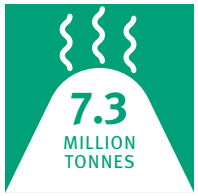


24.12 $MtCO_2e$

80% reduction in avoidable hospitality sector waste
6.82 $MtCO_2e$

80% reduction in avoidable household waste
17.3 $MtCO_2e$

One strategy for the biggest impact
Cut avoidable household food waste by 80 per cent



7.3 million tonnes of food was wasted by UK households in 2015

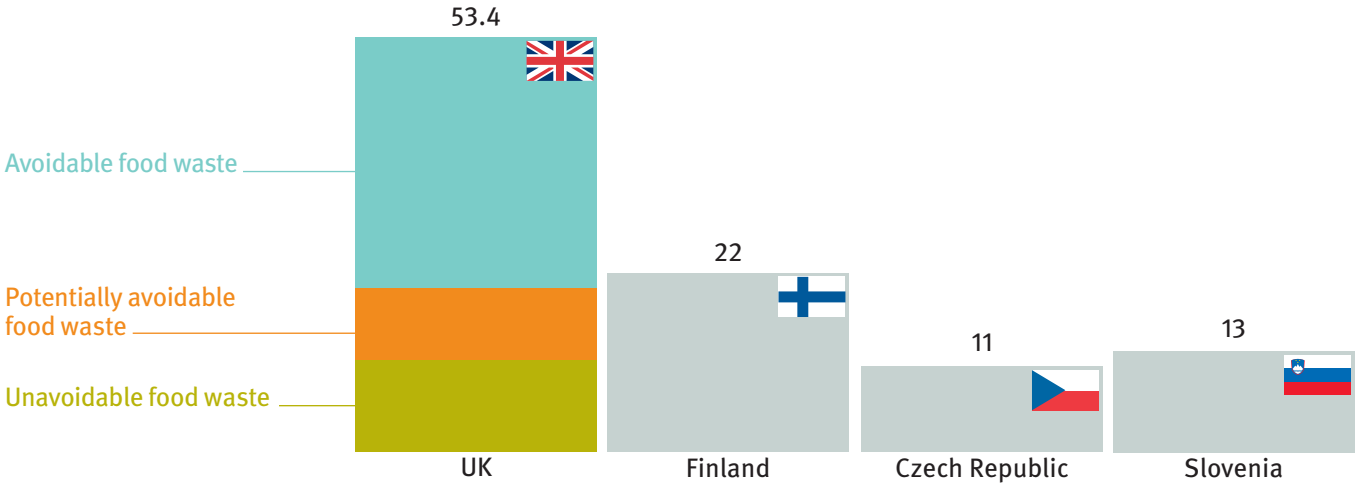
At least 60 per cent could have been eaten

Avoidable food waste costs the average family £700 a year[13]

According to WRAP, UK households waste nearly 20 per cent of the food they purchase. While some food wastes, like vegetable peels and egg shells, are unavoidable, most can be prevented. Avoidable food waste from UK households alone is responsible for 19 million tonnes of CO_2e every year.[14]

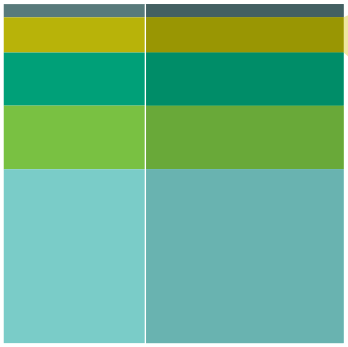
Reducing avoidable household food waste by 80 per cent, in line with other European countries, could reduce UK emissions during the fourth carbon budget period by as much as 7.16 $MtCO_2e$, and by more than 10 $MtCO_2e$ in the fifth.

Food waste (kg per person, per year)[15]



Electronics and appliances

Resource efficiency in the electronics and appliances sector could cut carbon emissions by 16.36 $MtCO_2e$ between 2023 and 2032. This would reduce the emissions overshoot by 11 per cent in the fourth carbon budget and eight per cent in the fifth.[16]



16.36 $MtCO_2e$

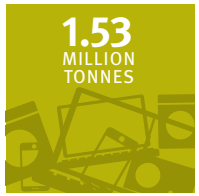
Replace a third of rarely used appliances purchased through sharing **0.28 $MtCO_2e$**

25% reduction in steel use
2.65 $MtCO_2e$

70% increase in remanufacturing
3.25 $MtCO_2e$

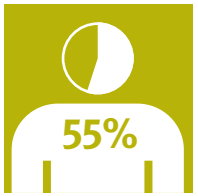
Increase reuse of electronics to 32%
10.18 $MtCO_2e$

One strategy for the biggest impact
Keep electronic goods in use



In 2015, 1.53 million tonnes of electrical items were discarded in the UK[17]

Nearly a quarter of the electronics people throw away are suitable for reuse[18]



55% of people would be 'likely' or 'very likely' to buy secondhand (at the right price)

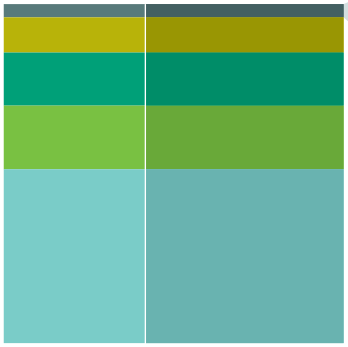
WRAP has estimated that a quarter of waste electronic items are fit for reuse, but most are landfilled or recycled. The same research showed that 55 per cent of people would be willing to buy used items.[19]

If all those people who would be happy to buy secondhand electronics could use all the products that are prematurely thrown away, it would save up to 4.21 $MtCO_2e$ in the fourth carbon budget and 5.97 $MtCO_2e$ in the fifth.

Destination of used UK electronics (WRAP, 2014)

Clothing and textiles

Resource efficiency in the clothing and textiles sector could cut carbon emissions by 6.09 $MtCO_2e$ between 2023 and 2032. This would reduce the emissions overshoot by four per cent in the fourth carbon budget period and three per cent in the fifth.[20]



6.09 $MtCO_2e$

30% reduction in supply chain waste
1.01 $MtCO_2e$

20% increase in closed loop recycling
1.08 $MtCO_2e$

30% increase in textile and carpet reuse
1.76 $MtCO_2e$

One year increase in clothing lifespan
2.24 $MtCO_2e$

One strategy for the biggest impact
Keep clothes in use for another year

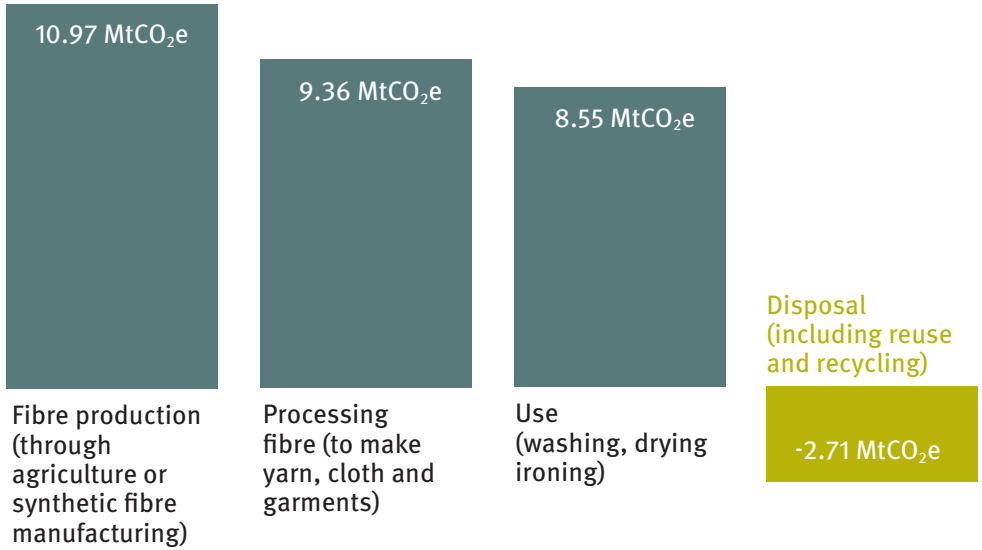
3.3 years: the estimated average lifetime for an item of clothing

One in three items of clothing have not been worn in over a year[21]

Keeping clothes in active use for an extra year could save 2.24 $MtCO_2e$ in the fourth and fifth carbon budget periods (equivalent to four times UK airplane emissions in 2016)[22]

So called 'fast fashion' has major implications for carbon emissions. Using textiles and leather goods for longer (and reducing the number of purchases) could have a big impact on the embodied emissions from this sector because fibre production and processing are the most carbon intense phases of clothing manufacture, according to WRAP. Simply increasing the average lifespan of an item of clothing by one more year could save 0.93 $MtCO_2e$ in the fourth carbon budget and 1.31 $MtCO_2e$ in the fifth.

The carbon footprint of clothing in the UK, by lifecycle stage ($MtCO_2e$)[23]



What the government should do: three simple steps

Using resources more efficiently has many benefits beyond material and carbon savings, including improving economic competitiveness, and expanding opportunities for UK businesses to export resource efficient products and services to the growing international market.

Despite the considerable potential demonstrated here, incentives for companies to increase their resource efficiency are currently weak. This can largely be attributed to:

- lack of expertise and strategic foresight;
- poor price signals (as materials and carbon are still relatively low cost and their environmental impacts are not reflected in their price).

Different sectors will also face their own specific barriers to improving material use. Targeted action is needed and the government is best placed to lead.

Other countries, like Japan and Germany, have shown what government leadership can do to help businesses become more resource efficient, reducing raw material use at the same time as boosting industrial competitiveness.

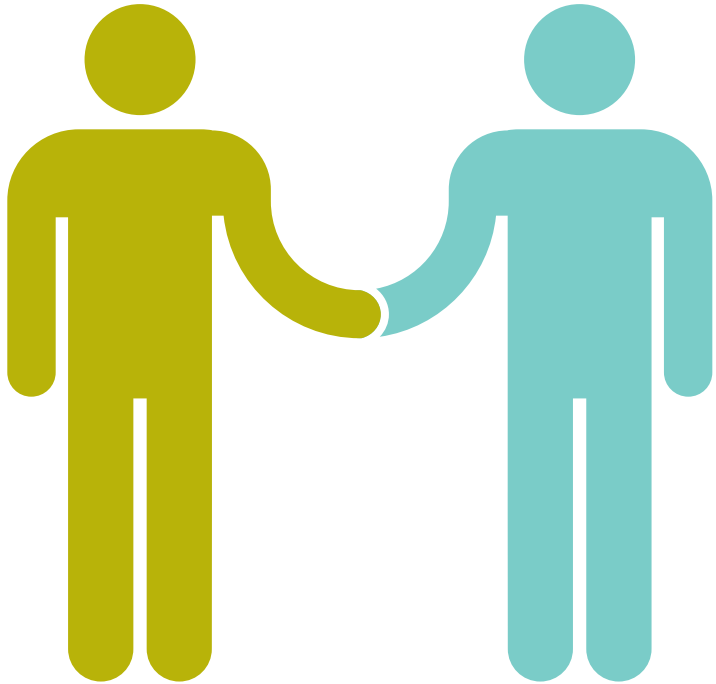
The German Resource Efficiency Programme (ProgRess) tracks resource efficiency and identifies existing and required policies. It sets targets to drive progress and help businesses improve their performance towards the main goal of doubling resource productivity by 2020.[24]

1.

Establish sector specific resource efficiency partnerships

The UK should follow Germany's example and set up a comprehensive resource efficiency programme. This could develop common data reporting metrics to help the government achieve its goal of doubling resource productivity by 2050 as set out in its Industrial Strategy.

The government should establish partnerships with key sectors, starting with the five described here. These should identify best practice, challenges and opportunities and set sector specific standards, to achieve whole lifecycle savings of both carbon and materials.



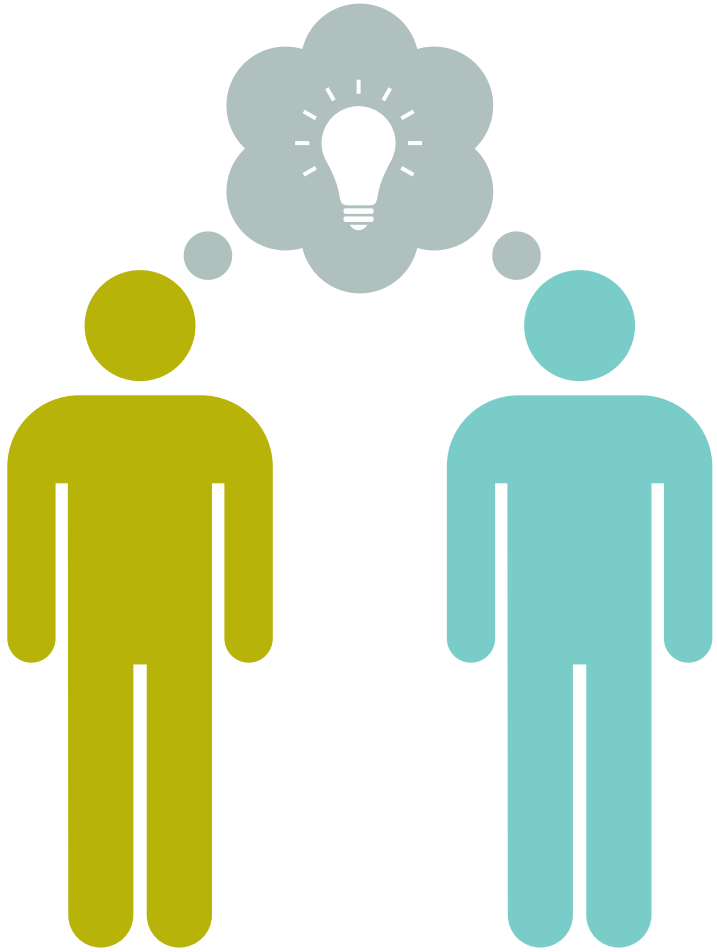
2. Demonstrate and disseminate innovation

Working in conjunction with UK Research and Innovation, the new resource efficiency partnerships could administer low cost loans to develop resource efficient products, processes and business models, targeted at:

1. a technology, process or business model with potential for significant savings; or

2. large scale deployment of existing resource efficient options.

The resource efficiency partnerships could disseminate results and best practice to businesses. These should also be incorporated into government procurement standards.



3.
Regulate where necessary

After establishing a clear system of reporting and identifying best practice, the government should consider implementing sector specific targets to achieve absolute reductions in whole life carbon emissions and material use. These could initially be voluntary but, if sufficient progress is not made, the government should move to statutory targets.

Overall, this should support the use of lower impact materials and less resource intensive designs in production (putting less in) and greater product longevity and reuse at end of life (getting more out).

Endnotes

1 The emissions reduction potential was calculated by researchers from the Centre for Industrial Energy, Materials and Products (CIEMAP), due to be published in a forthcoming paper. Emissions reductions would vary depending on uptake by consumers and manufacturers as well as the amount of material savings per product. The figures included in this report represent the maximum reductions from resource efficiency CIEMAP's researchers consider technically or theoretically feasible for the sectors modelled through a multiregional input-output simulator. The emissions savings come from designing buildings, cars and appliances to use less material or less carbon intense material and to last longer. They do not account for emissions savings from operational energy use, for example from reduced vehicle exhaust emissions from electric vehicles. The savings modelled are additional to those achieved by planned and existing policies that address operational emissions and only include emissions in the scope of domestic targets, meaning further emission reductions would occur along product supply chains outside the UK. In addition to the sectors discussed in this briefing, the CIEMAP researchers also modelled carbon savings from resource efficiency measures in the packaging and furniture sectors, as well as from some other machinery. As the researchers have not considered all economic sectors, there will be additional, similar resource efficiency opportunities in other areas. Finally, in line with common academic practice, the researchers' projections of resource efficiency's impacts starts from 2013, the first year of the second carbon budget and the latest year actual data is available. Delaying efforts until 2018 means that implementation rates of resource efficiency will need to be greater and ambition increased to achieve the equivalent carbon emission reductions.

2 BEIS, January 2018, *Updated energy and emissions projections 2017*

3 J Barrett et al, 'Consumption-based GHG emission accounting: a UK case study', in *Climate Policy,* Volume 13, 2013 – Issue 4

4 BEIS, January 2018, op cit. Our graph is based on 'Annex D: Policy savings in the projections'. For simplicity, we have combined the savings from similar policies (eg the savings from the different iterations of the Building Regulations (part L) are grouped together). 'Resource efficiency potential' is based on CIEMAP's projections.

5 CIEMAP's researchers modelled three approaches: 1) improvements in design to reduce material inputs to construction by up to nine per cent, depending on the application, including: optimised roll-out of reinforcement steel meshes; optimal design practices and building information modelling (BIM); steel savings for standard universal beams; and lightweighting steel used in railways; 2) substitution of lower carbon intensity materials, including: a 500 per cent increase in wood use combined with a 15 per cent reduction in steel and a 70 per cent reduction in brick; increased use of other biotic materials including prefabricated panellised straw bale; and use of biocomposites; 3) an increase in material reuse of steel, structural timber, brick and other construction materials. Currently, five per cent of steel is reused, for instance, but the researchers modelled a scenario where 35 per cent of construction steel was reused.

6 CIEMAP, 2018, *Reducing carbon in construction: a whole life approach*

7 Figures cited are for the carbon footprint at the point of construction. According to the Atkins Masterplanning Tool (2010), the average university building has a carbon footprint of 845kgCO_2/m^2. Using Rapiere software, the project architects at Architype estimate that the year zero embodied footprint for the Enterprise Centre was 193kgCO_2/m^2. Over its 100 year lifespan, the whole life carbon emissions of the building have been estimated to be 440kgCO_2/m^2.

8 CIEMAP's researchers modelled reductions in industrial energy demand in the vehicles sector, including: reducing the weight of steel used in vehicles by 45 per cent, and the weight of aluminium and other materials in the vehicle body by 25 per cent (in both cases without material or alloy changes); reducing manufacturing losses by up to ten per cent for steel and 20 per cent for other materials; increasing the refurbishment of steel parts used in vehicles by up to six per cent; shifting from recycling to refurbishment of cars to save up to 15 per cent of materials required for manufacture; and making cars last four years longer (including increasing the use of car clubs).

9 CIEMAP, 2016, *Understanding consumption: why and how do we use products?*

10 CIEMAP, 2017, *A whole system analysis of how industrial energy and material demand reduction can contribute to a low carbon future for the UK*

11 A Rodrigues, et al, 2015, *Driving in the wrong lane: towards a longer lifespan of cars*

12 CIEMAP's researchers modelled a scenario where 'avoidable food waste' (food that definitely could have been eaten) from both households and hospitality sectors was reduced by 80 per cent. This means that around ten per cent of food would continue to be wasted, but most of it would be unavoidable. 'Potentially avoidable food waste' is that food which some people eat though others do not, eg potato peel. Additional savings could also be achieved through reducing food waste at the manufacturing and retail stages.

13 WRAP, 2016, *Household food and drink waste in the United Kingdom 2015*

14 Ibid

15 European Commission, 2010, *Preparatory study on food waste across EU 27*

16 CIEMAP's researchers modelled: a 27 per cent reduction of steel used in electronics (without changing material, alloys or equipment function); increasing sharing of less frequently used electrical appliances and handheld power tools to 33 per cent; increasing reuse of prematurely disposed of electronics to 55 per cent; and increasing remanufacturing of electronics and computers to reduce material input by 15 per cent and energy input into manufacturing by 70 per cent.

17 WRAP, 2017, *Switched on to value: Powering business change*

18 WRAP, 2014, *Switched on to value*

19 Ibid

20 For resource efficiency in the textile sector, CIEMAP's researchers modelled carbon savings from: a 30 per cent reduction in fibre and yarn wasted in production; a 30 per cent increase in reuse of both clothing and carpets (displacing new purchases); a 20 per cent increase in closed loop recycling of clothing and carpets (again, displacing new purchases); and a one year increase in the lifetime of clothing and leather goods.

21 WRAP, July 2017, *Valuing our clothes: the cost of UK fashion*

22 Based on the fact that UK civil aviation accounted for 1.5 MtCO_2e in 2016, according to: BEIS, 2018, *2016 UK greenhouse gas emissions: final figures – data tables*

23 WRAP, July 2017, op cit

24 German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, 2015, *German resource efficiency programme II: programme for the sustainable use and conservation of natural resources*

Less in, more out: using resource efficiency to cut carbon and benefit the economy

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Centre for Industrial Energy, Materials and Products

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