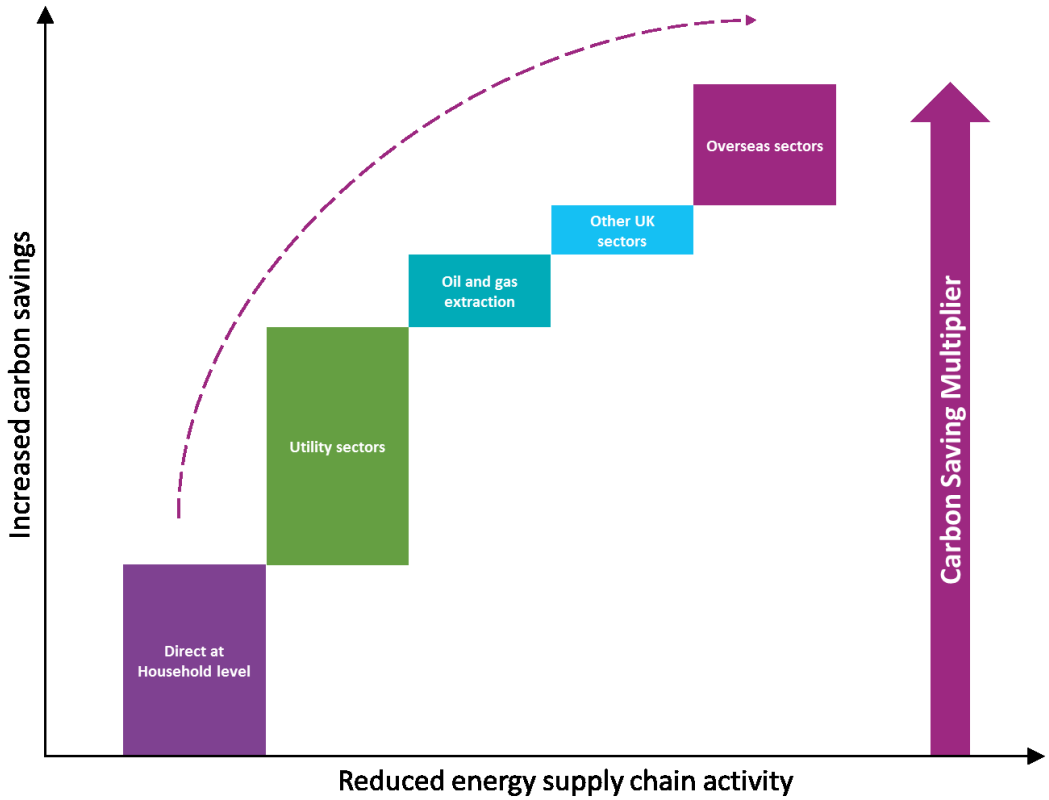
Just how much carbon do we save when we increase our energy efficiency?

Reduced emissions in households – is that all we can expect?

Suppose households increase the efficiency with which they use gas so that they can heat their homes to the same degree for the same time each day, but using less physical gas. This will reduce carbon emissions directly emitted by households. However, **where households demand less gas, this will also reduce output requirements in the energy supply chain** (see figure below). Thus, further reductions in emissions may be expected in the utility sectors themselves (gas, electricity and water supply) but also further up the supply chain, including the extraction of oil and gas and other sectors (service and industrial) within UK and overseas supply chains. Reflecting this argument, our project proposes use of a metric called a **Carbon Saving Multiplier (CSM)** that reports the total kg (or tonne) of carbon saved throughout the energy supply chain per kg (or tonne) directly saved within the household sector.



How can we use the carbon saving multiplier metric?

The example over the page considers a case where the carbon saving multiplier takes the value of 2.69. This means that for every kg reduction in carbon emissions at the household level, another 1.69 kg are saved throughout the global energy supply chain. This is linked to a £10 (per week) reduction in the household energy bill due to increased energy efficiency (e.g. due to the installation of a more efficient boiler).

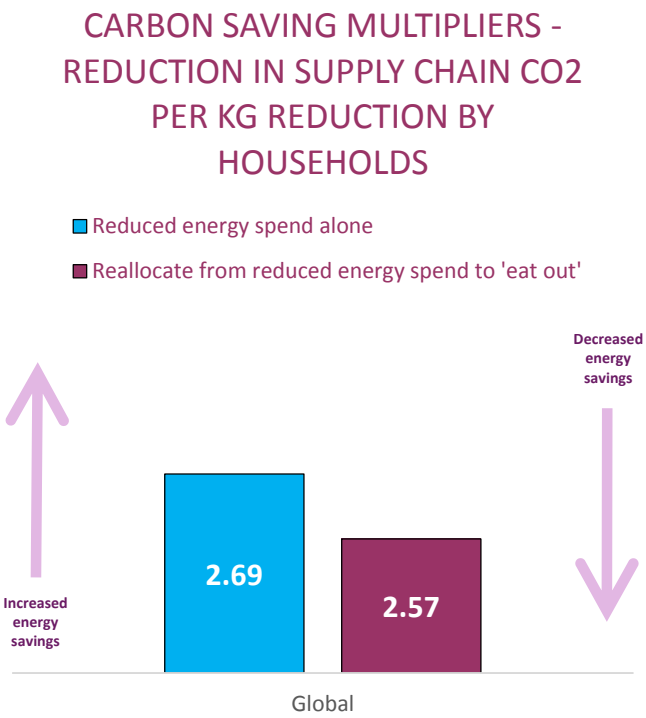
However, we must also consider the implications of the £10 saved being spent on other things. Everything we consume will involve the emission of carbon at some point(s) in its supply chain and this will **erode the value of the CSM at home and abroad**. The key question is by how much and where (countries and industries).

UNIVERSITY of STRATHCLYDE
INTERNATIONAL PUBLIC POLICY INSTITUTE
CENTRE FOR ENERGY POLICY

Research Councils UK
Energy
For a Low Carbon Future

An example using the Carbon Saving Multiplier (CSM)

We consider the nature of the global CSM where UK households increase efficiency in their use of electricity, gas and water (all utilities) leading to savings in the utility bill of £10 per week and a reduction in weekly CO_2 emissions at household level of 6.4 kg. An additional 10.9 kg less CO_2 is emitted globally throughout the utility sector's supply chain. Most of this (9.6 kg) is emitted within the UK, and within the wider utilities sector itself. Thus, the total global CO_2 savings are 17.3 kg, or 2.69 for every kg saved a the household level, with 2.56 of the CSM located within the UK.



We also consider the case where the £10 saved is spent, selecting the example of eating out at hotels or restaurants within the UK. The upstream supply chain for UK hotels and restaurants is less CO_2-intensive than utilities. However, it involves CO_2 emissions in a wider range of industries and countries. The high level result is that **the global CSM is eroded from 2.69 to 2.57**. Gross increase in CO_2 emissions are located in agriculture, food/beverage and transportation industries in a range of countries (including the UK). The largest gross increases in national CO_2 emissions occur in The Netherlands, France and India.

Some details about the example studied

In order to take a global view of the CSM and carbon emissions, we used the World Input-Output Database* produced via an EU FP7 funded project. This involved a trade-off relative to what could be achieved with a national UK focus and data produced by ONS. For example, we had to work with quite highly aggregated sectoral data (e.g. an aggregated Electricity, Gas and Water Supply sector). Our full study is detailed in a paper due to be published in the journal Energy Policy (see below).

The project 'Energy saving innovations and economy wide rebound effects' is funded by the EPSRC under the 'Working with the End Use Energy Demand Centres' call (EPSRC Grant Ref: EP/M00760X/1). Research outputs and policy briefings are available from the project website (see below). The work on the CSM is currently available in a corrected proof version in the following link:
http://www.sciencedirect.com/science/article/pii/S0301421516307224

Contact for CSM work: antonios.katris@strath.ac.uk
Contact project leader: karen.turner@strath.ac.uk
Project website: www.cied.ac.uk/research/impacts/energysavinginnovations
CEP website:
http://www.strath.ac.uk/research/internationalpublicpolicyinstitute/centreforenergypolicy/

*** The WIOD data that have been used in our study are available at this website: http://www.wiod.org/release13**

UNIVERSITY of STRATHCLYDE
INTERNATIONAL PUBLIC POLICY INSTITUTE
CENTRE FOR ENERGY POLICY

Research Councils UK
Energy
For a Low Carbon Future