The Power of Carbon Psychology

A report for npower Business Solutions

September 2016

npower Business Solutions

An RWE company

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Executive Summary

Energy efficiency – the ability to deliver the same output or services with lower energy input – is increasingly a goal for governments, businesses and households. In an environment of rising and volatile energy costs, as well as increased uncertainty over the UK's capacity of electricity generation over the next decade, the potential gains from energy efficiency have taken on even greater significance. This study focuses on the UK's recent record in promoting energy efficiency, both through resources committed to Research and Development (R&D) expenditure, and policy designed to encourage behavioural change amongst businesses. Cebr and npower Business Solutions (nBS) believe that more could be done to promote energy efficiency through behavioural change, particularly amongst larger businesses. Therefore this study also seeks to quantify the potential monetary savings that larger businesses could achieve by promoting behavioural change amongst employees.

Evidence suggests that businesses investing in energy efficiency do not just experience reductions in costs over the long run, but also help shield themselves against future uncertainties around energy prices. In addition, other potential benefits include greater profitability, higher retention of employees and stronger "green" credentials when seeking public sector contracts. In order to assess the UK's record on energy efficiency and estimating savings from behavioural change, the study combines evidence and insights from macroeconomic and business-level data, policy evaluation information and academic literature. We have drawn upon data and insights from the former Department of Energy and Climate Change (DECC) and other bodies such as the European Energy Agency (EEA). We find that:

- Recent studies and evidence suggest that behavioural change can be effective in raising business energy efficiency. Whilst schemes such as the Energy Savings Opportunity Scheme (ESOS) and the roll-out of smart-meters are welcome, there is scope for greater promotion of behavioural change amongst larger businesses. Moreover, there is evidence to suggest that a combination of technological improvements and measures to promote behavioural change will be most successful in raising energy efficiency amongst UK businesses. Potential savings suggested by the literature could be as high as 20%, depending on the number and type of behavioural change measures used.

- In terms of promoting energy efficiency through Research and Development (R&D) expenditure, the UK has a mixed record. As a share of its GDP, the UK is estimated to have spent 0.05% on energy efficiency R&D in 2013; this compares favourably to some countries such as Norway (0.01%) but less so with countries such as Finland (0.13%) and Germany (0.06%). The UK however performs more strongly if expenditure on energy efficiency is expressed as a share of total energy R&D, committing around 30% if using this measure, against France (15%) and the US (21%).

- Using an approach based on the number of employees in UK businesses, we present a central esti-mate of just over £600 million of potential savings that could be achieved by UK businesses fostering behavioural change among their employees, of which over a third (£270 million) could be achieved by large businesses alone. As an upper limit, we estimate that potential business savings of just under £860 million could be achieved, of which £460 million could be achieved by large businesses.

- To place these potential business savings in context, savings of £270 million equate to electricity sav-ings of just over 2,700 Gigawatt hours (GWh), or a 0.5% reduction in total energy purchases by UK businesses. Potential savings from large businesses form a disproportionately high share of total savings under each of our scenarios.

- Within the potential business savings of £600 million, we estimate that the greatest scope for savings lies in the following sectors: Wholesale and Retail (£120 million), Manufacturing (£64 million), Administrative and Support services (£69 million) and the Professional, Scientific and Technical (£55 million).

1.0 Introduction

1.1 Background and aims of the study

The Centre for Economics and Business Research (Cebr) and npower Business Solutions (nBS) have worked in partnership to produce this report, which examines the positive impact that behavioural change could have on businesses through energy savings. The primary objective of the report is to quantify the potential energy savings that UK businesses could achieve by successful embedding behavioural change amongst their employees.

Energy efficiency does not only have a role in reducing the UK's energy usage over the coming years; it adds value in the real economy as well. In 2013 the former Department of Energy and Climate Change (DECC)[1] estimated that the UK energy efficiency sector was worth more than £18 billion and supported 136,000 jobs across the UK.[2] The UK Government has sought and implemented new policies to build on the UK's strong position as one of the most developed nations in the world with regards to energy efficiency. Such policies include the Green Deal, the Energy Company Obligation (ECO), the establishment of the Green Investment Bank, as well as the wider roll-out of smart meters across Great Britain.
The Government is actively seeking to promote the use of energy efficient plant, machinery and technology. An example of this is the Energy Technology List (ETL), a government-managed list of energy-efficient plant and machinery, the use of which enables businesses to claim tax breaks through Enhanced Capital Allowances (ECA).

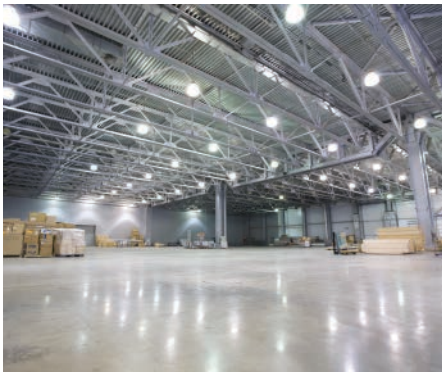
However, evidence and insight from a variety of sources suggests that there is scope for UK businesses – particularly larger businesses – to contribute to higher levels of energy efficiency by promoting behavioural change amongst employees. "Behavioural change" is defined here as non-technical changes which result in greater energy efficiency, for the most part consisting of employees changing their habits or behaviour. Changes can be induced through training and information, either through feedback delivered on energy use, or through concerted, company-led efforts and initiatives to change energy use habits. Whilst the mode of delivering behavioural change will vary from company to company across different industrial sectors, it could for example consist of:

- Better use of office and industrial equipment
- Reducing office room temperatures
- Increased use of energy efficiency dashboards, providing real-time data on energy use
- Introducing Knowledge Performance Indicators (KPIs) to track energy efficiency
- Greater use of performance management concerning energy use
- Switching-off idle office and industrial equipment

The primary objective of this study is to identify the energy savings that could result from behavioural change – in other words, the opportunity for the UK businesses across the UK.

A direct comparison of the energy efficiency savings that could be achieved through technology change versus behavioural change lies beyond the scope of this report. Investment in technology improvements will still be necessary to build on existing improvements in energy efficiency; but there are additional gains that could be achieved through behavioural change. Supporting this is an array of evidence to suggest that efficiency gains from technology change will be enhanced by behavioural change, and that energy efficiency measures are at their most effective when both measures are combined. Therefore the potential behavioural change savings that could be achieved by businesses – as estimated in this report to be substantial – are likely to be boosted further if combined with further technology improvements.

1.2 Structure of the report



The report is structured as follows:

- Section 2 sets out the scope of the report and analysis
- Section 3 covers the UK record in energy intensity at a national, household and industrial level
- Section 4 examines the UK record in promoting energy efficiency through R&D expenditure, as well as its policy record in implementing policy designed to elicit behavioural change
- Section 5 provides a review of the evidence concerning behavioural change and energy efficiency
- Section 6 examines the potential savings that UK businesses could make from promoting behavioural change amongst their employees.
- Annex A further details the approach and methodology used in Section 6.

2.0 Scope

2.1 Scope of the study and analysis

In this report we examine trends in energy efficiency, the potential role which engendering further behavioural change could play in promoting energy efficiency amongst UK businesses, and the size of these potential savings that could be achieved through behavioural change. We place particular focus on larger businesses; we estimate that these businesses could potentially achieve the largest savings.

Energy efficiency is an outcome in which a reduced amount of energy is needed to provide goods and services. The International Energy Agency (IEA) defines energy efficiency as "a way of managing and restraining the growth in energy consumption. Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input."[3] In this context, it can be thought of as a business using less energy to provide the same level of output or service.[4]

There are many reasons for why different groups seek to promote energy efficiency. For individuals, increasing energy efficiency by installing better insulation or using new Light Emitting Diode (LED) light bulbs can lower household energy bills. For businesses, reducing energy waste can also directly reduce their energy costs but is also linked with wider benefits such as increased cash flow and profitability, competitiveness and retention of employees. For governments, there are security and macroeconomic benefits as greater energy efficiency can help reduce reliance on energy imports and help control emissions.

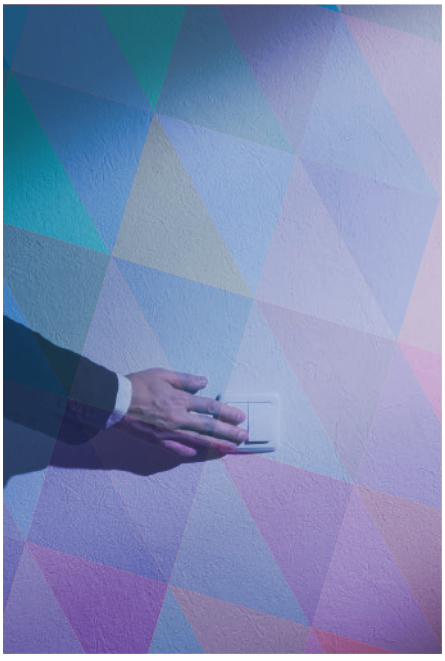
To assess the UK's record in promoting energy efficiency, the report draws upon macroeconomic and policy-level data from the IEA, the Office for National Statistics (ONS) and European-level sources. To examine the potential savings from behavioural change, the analysis also combines business-level data on businesses from the former Department for Business, Innovation and Skills (BIS), the former Department for Energy and Climate Change (DECC) and the Carbon Trust.

2.2 Overview of approach and methodology

We start by examining on a holistic level the UK's performance in energy intensity when compared to other countries, and how levels of energy intensity have changed over time (reflecting energy efficiency gains or otherwise) at both a household and industrial level. We then examine the policy environment by evaluating the UK record in promoting energy efficiency through Research and Development (R&D) and policy measures designed to promote behavioural change. We then use these comparisons to demonstrate whether there is scope to raise energy efficiency through behavioural change policy.

We then conduct a review of the evidence concerning energy efficiency and behavioural change, as taken from a variety of reputable sources. We also look at how behavioural change is promoted amongst households and businesses and examine any differences between them. We then use this review to inform our subsequent analysis on potential business savings.

After examining the potential for behavioural change, we then seek to quantify the potential savings that UK businesses could achieve through successfully implementing behavioural change. We use findings from academic literature and other related sources as the assumptions to drive this analysis, combining this with company data sourced from the annual Business Population Estimates (BPE).



3.0 Recent UK performance in energy intensity

In this section we examine trends in energy intensity in the UK at both a national and industrial level, comparing the UK position to that of other countries. This then provides context for the remainder of the report, particularly for industrial energy efficiency.

Headlines

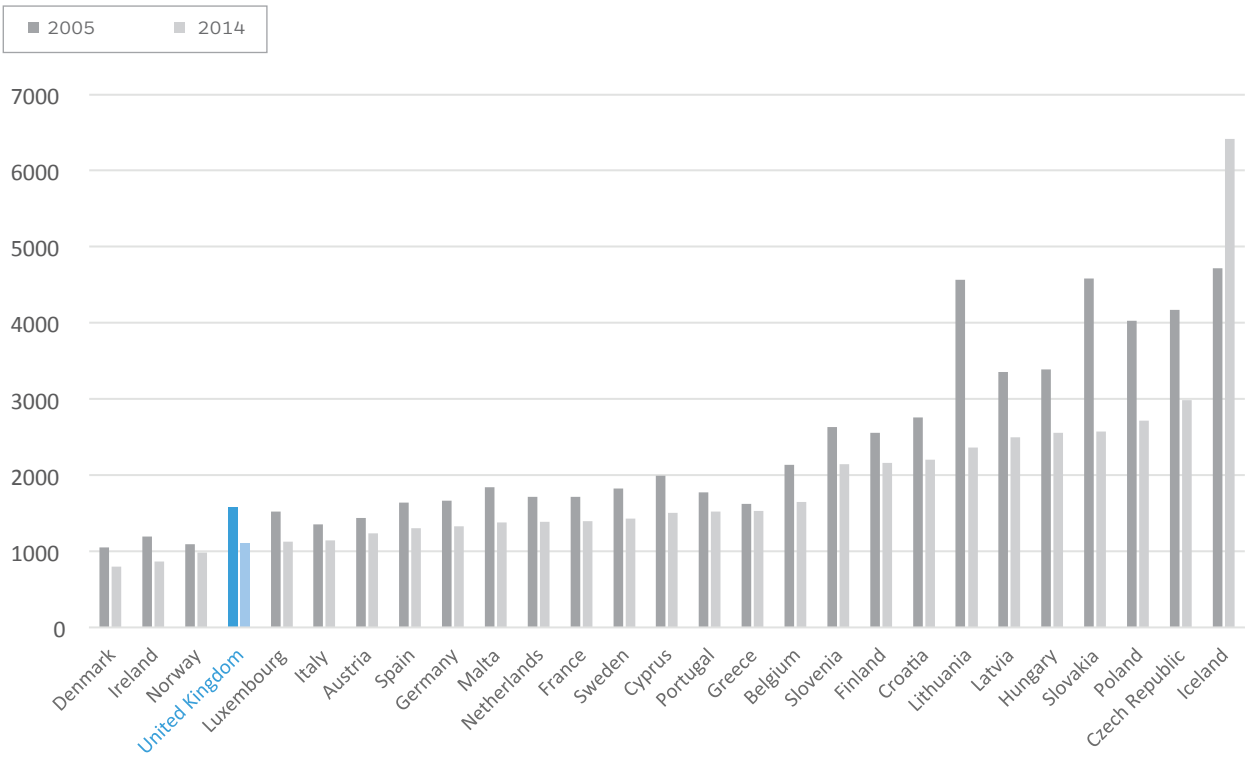
Our analysis of energy intensity trends across European countries shows that:

- The UK has one of the lowest levels of energy intensity compared to other countries, comparing favourably to other countries such as France, Germany, Sweden and Italy. Total energy intensity across all sectors in the UK fell by around 30% between 2005 and 2014;
- However, the UK's performance in reducing industrial energy intensity is more mixed. UK industrial energy intensity fell by 16% between 2005 and 2014, below the European average of 18%. In addition, there is evidence to suggest the reductions in industrial energy intensity have slowed since 2007, particularly in the UK;
- The UK has experienced stronger performance in reducing household energy intensity, reducing this by 20% and only bettered by Belgium (34%) and far higher than the European average of 3%.

3.1 Comparing energy intensity across European countries

We start by identifying where the UK currently sits in terms of its energy intensity, as defined and measured by gross consumption of energy divided by Gross Domestic Product (GDP). In Figure 1 below, we compare rates of observed energy intensity across European countries between 2005 and 2014:

Figure 1: Gross inland consumption of energy divided by GDP (Kilowatt hour per €1,000) by European country



Source: Eurostat

The UK has one of the lowest rates of energy intensity overall when compared to other European countries. In 2014 the UK consumed 1,112 Kilowatt (KWh) of energy for each €1,000 of GDP produced, with energy intensity having fallen from a rate of around 1,580 KWh in 2005. The UK position in 2014 compares favourably to that of countries such as Germany (1,330 KWh), France (1,400 KWh) and Finland (2,200 KWh); the least energy intense countries were Denmark (800 KWh) and Ireland (900 KWh). The UK has also experienced one of the highest reductions in energy intensity, a fall of 29.7% between 2005 and 2014; this compares to Ireland (27.4%), Germany (20.2%) and France (18.5%). The greatest reductions were in Lithuania (48.2%) and Slovakia (43.8%). The UK's relatively low energy intensity is partly attributable to the UK's greater reliance on services (as opposed to energy-intensive industry) but the IEA[5] have also acknowledged improvements achieved in energy efficiency as a contributing factor.

The next step is to examine what has driven the improving UK trend in energy intensity during this period. Overall energy usage is typically disaggregated into the sectors of industry, households, transport, and the tertiary sector (services). We examine country-by-country trends in energy intensity across the household and industrial sectors in the remainder of this section. For households, energy intensity can be measured by the average energy consumption per household (combining electricity and gas); this is the most commonly-used measure used by the EEA, the EIA and other bodies.

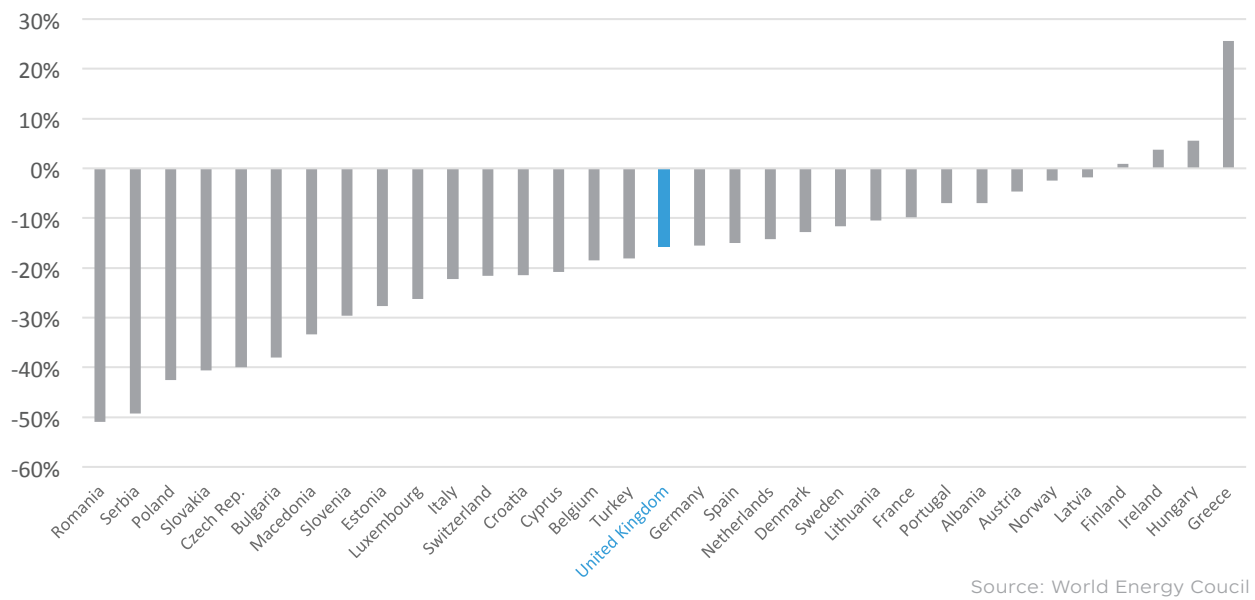
For industry, energy intensity can be measured by energy consumption per unit of Gross Value Added (GVA). GVA[6] is a measure of the value from production in national accounts, representing the value of 'industrial' output less the value of the inputs used to produce that output. That is, it is the value of what is produced less the value of the intermediate goods and services used as inputs to produce it. So in this context, energy intensity broadly relates to the energy used to produce each additional unit of output.

The industrial sector

Figure 2 below shows the reduction in industrial energy intensity in Europe between 2005 and 2014:

The UK has one of the lowest rates of energy intensity overall when compared to other European countries.

Figure 2: Reduction in energy intensity in Industry by European country, 2005 – 2014



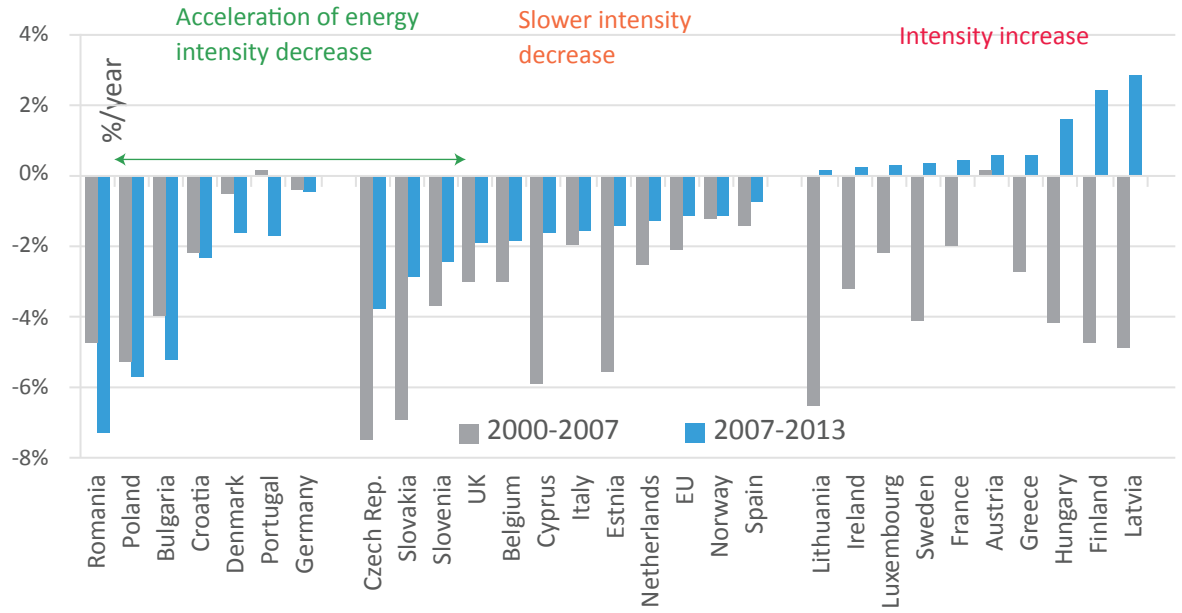
Source: World Energy Coucil

UK industrial energy intensity fell by around 16% in this period, comparable to Germany (15%) and Belgium (19%) but below the European average of approximately 18%. It is notable that not all countries have experienced a reduction in industrial energy intensity between 2005 and 2014; four countries – Finland, Ireland, Hungary and Greece – have actually experienced an increase in energy intensity (Greece in particular experienced a 26% rise in industrial energy intensity in this period).

The UK therefore appears to be in a relatively average position in terms of reductions in industrial energy intensity since 2005. There are however several factors that appear to have influenced the downward trend, not all of which relate to energy efficiency. BEIS[7] have identified a shift in economic activity away from heavy, energy intensive industries – particularly chemicals and iron and steel manufacturing – as a factor. In Europe, The French Environment and Energy Management Agency ADEME[8], through its ODYYSEE MURE project, has identified a significant change in industrial energy intensity trends occurring in 2007. ADEME attribute this slowdown in the energy intensity of industry to contraction in construction activity across Europe. In addition, there has been an increase in the energy contribution of energy-intensive industry branches, particularly chemicals in the Netherlands and the UK.

Prior to 2007, industrial energy consumption across Europe was relatively stable as increased industrial activity was offset by energy savings. Since 2007, whilst energy consumption has fallen across all industrial branches, it is estimated that only around 25% of the reduction in industrial energy consumption was related to energy savings; over half is instead attributed to a decrease in industrial activity following the so-called Great Recession. Reductions in industrial energy intensity have resulted from large equipment not operating to full capacity whilst consumption levels as a whole did not fall. As a result, energy savings are estimated to be 250% lower since 2007 than between 2000 and 2007. Figure 3 below shows trends across different countries in the pace of energy intensity reductions, split by the 2000 – 2007 and 2007 – 2013 periods. The UK is grouped in the category of countries in which reductions in energy intensity has been slower in recent years.

Figure 3: Trends in industry energy intensity across European countries, 2000-07 versus 2007-13

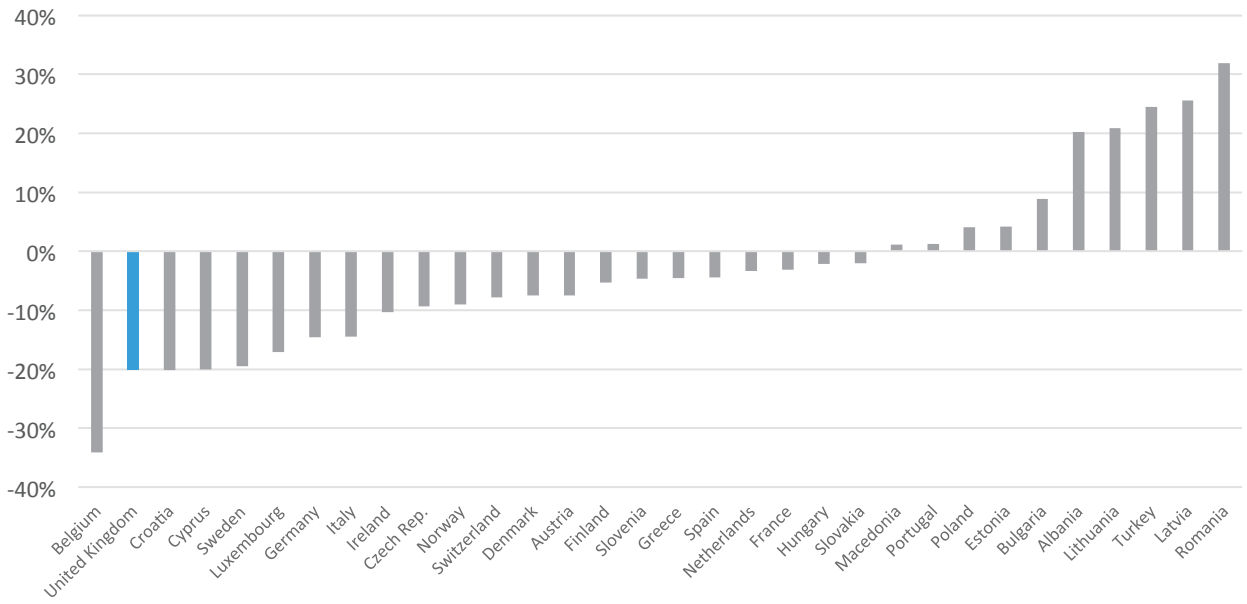


Source: World Energy Coucil

The household sector

In contrast to the industrial sector, the UK appears to have performed more strongly in comparison to other countries in raising household energy efficiency in recent years. Figure 4 below shows the reduction in energy intensity across households in different European countries between 2005 and 2014.

Figure 4: Reduction in average household energy usage by European country, 2005 – 2014



Source: World Energy Coucil

Average household use of energy in the UK fell by just over 20% in this period, comparable to Germany (15%) and Belgium (19%) and far in excess of the European average of approximately 3%. The European Environment Agency (EEA) estimate that half of the efficiency gains achieved through technological innovations in the household sector were offset by the increasing number of electrical appliances in use and larger homes.[9] In its latest Energy Consumption in the UK publication, BEIS[10] identify the increasing prevalence of energy efficient boilers and double glazing, as well as higher rates of cavity wall, solid wall and loft insulation, as factors driving downward pressure on household consumption and raising energy efficiency. Over the longer term, the gradual replacement of the older, poorly insulated housing stock with newer, more energy efficient homes is also expected to lower household consumption.

Behavioural change is also likely to have been a contributing factor to the reduction in household energy use; put simply, innovations such as LED bulbs and more efficient boilers still need to be actively purchased by sufficient numbers of households (and used correctly) for efficiency gains to be realised. There is a wealth of evidence on the means by which households have and would be able to achieve savings through behavioural change. Using natural field experiments, Dolan and Metcalfe[11] find that changing social "norms" can also change household energy behaviour. In one experiment in which households in Camden were shown their energy consumption compared against other households (a "descriptive norm") and statement reporting on their energy use (an "injunctive norm") as well as other information on their energy consumption. Social norms are found to reduce consumption 6% over a 15 month treatment period.

Separately, Abrahmse and Steg[12] identify "perceived behavioural control" as being a key determinant of energy use and intention to reduce energy use. Perceive behavioural control is the extent to which households feel capable of conserving energy (for example, "I know how I can save energy", or "I think it is

Smart meters and informative billing improve energy efficiency by empowering consumers to make better decisions and change behavior.

realistic to reduce my energy use by 5%"). Household respondents with higher levels of perceived behavioural control and more positive attitudes towards energy conservation were found to have stronger intentions to reduce energy use.

ADEME has also examined trends in household energy efficiency across European countries. They separately attribute energy efficiency gains to improvements in space heating and the diffusion of more efficient new electrical appliances. The largest improvements are attributed to better space heating (20%), followed by improvements in water heating and large appliances (15%). Smart meters and informative billing are highlighted as helping to improve energy efficiency, by empowering consumers to make better decisions and change behaviour. Using its energy efficiency index ODEX[14], ADEME identify that the large improvements in household energy efficiency have occurred in Cyprus, Sweden, Luxembourg, Latvia, UK, Portugal, Belgium and Ireland, with these countries achieving improvements which are twice as high as the EU average.

In the next section we turn to the UK's recent record in promoting energy efficiency, both through Research and Development (R&D) expenditure designed to improve energy efficiency, and policies designed to encourage behavioural change amongst businesses.

Summary

Our analysis of potential energy savings amongst UK businesses finds that:

- The UK is a relatively energy efficient country when levels of energy intensity are compared across European countries. Similar reductions in energy intensity have been achieved between 2005 and 2014 across the key sectors of households, industry and services.
- In achieving significant reductions in energy intensity amongst households, the UK compares favourably against other European countries, and has been identified by ADEME as having achieved improvements twice the EU average. Evidence suggests that policy has been successful to some extent in raising household energy efficiency.
- The UK continues to have one of the lowest levels of industrial energy intensity when compared to other European countries; in 2014 only Switzerland and Albania recorded lower levels of energy intensity. However, the UK record in reducing industrial energy intensity is fairly average in comparison to other countries, which have achieved greater reductions in energy intensity since 2004. Reductions in industrial energy intensity have slowed across Europe since 2007, including the UK.
- There is therefore scope to continue to raise energy efficiency in the UK's industrial sector, to match the increased energy efficiency achieved amongst households.

4.0

The UK record in promoting energy efficiency

Here we examine the UK's record in promoting energy efficiency. We have assessed the policy record through its Research and Development (R&D) expenditure designed to raise energy efficiency, and the active policy measures designed to engender behavioural change amongst businesses.

Headlines

We have compared the UK record in promoting energy efficiency both through Research and Development (R&D) expenditure and policies designed to promote behavioural change. We find that:

- The UK has committed an increasing share of its national output to R&D relating to energy efficiency. Based on the latest available data for 2013, the UK committed 0.03% of its Gross Domestic Product (GDP) in R&D expenditure relating to energy efficiency; this compares to an average of 0.03% across the 29 countries considered. This also compares favourably to the UK R&D commitment in 2006, which was only 0.01%. If R&D expenditure on energy efficiency is expressed as a share of all R&D expenditure relating to energy, the UK share was 30.1% in 2013 – higher than the 29-country average of 22.3%.
- Only a selection of European countries appear to have active policies designed to encourage behavioural change across industry and households, of which the UK is one. Within UK industry, expected energy savings by 2020 resulting from behavioural change policy (5,500 GWh) are dwarfed by expected saving from other measures (24,900 GWh).
- Far higher energy savings are expected amongst UK households (55,400 GWh), with behavioural change measures again only contributing to a small share of savings (6,800 GWh).

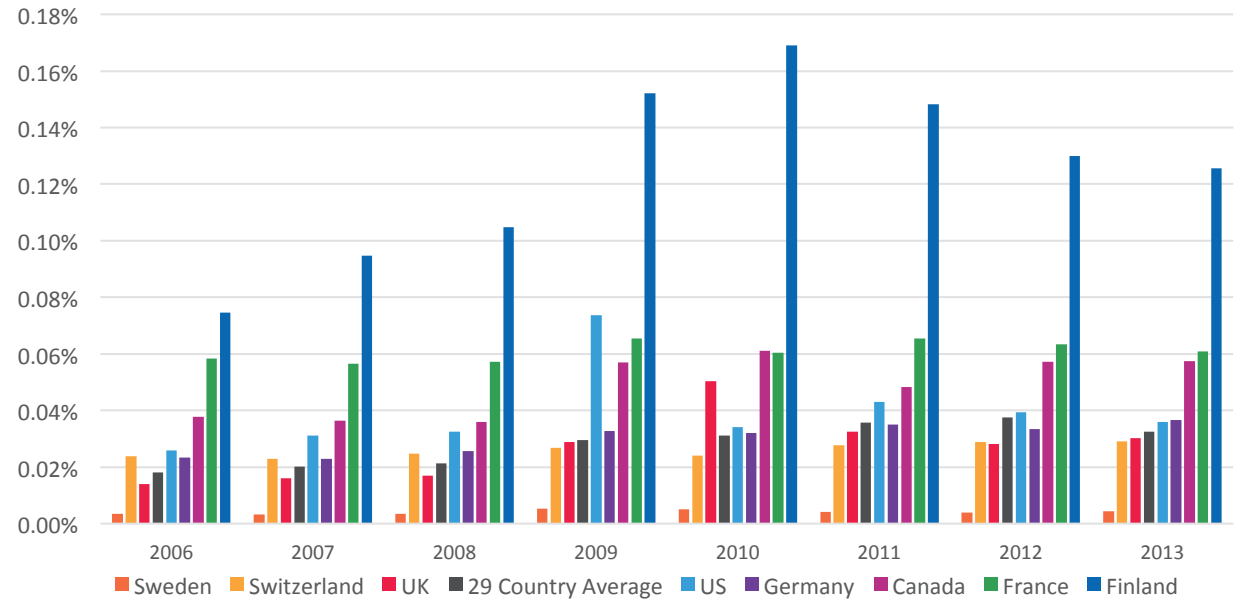
4.1 R&D expenditure and energy efficiency

Here we examine how much the UK commits in R&D expenditure designed to promote energy efficiency each year. R&D expenditure data has been sourced from the International Energy Agency (IEA) Data Services database.[15] In order to enable a comparison against other countries, R&D expenditure amounts have been expressed as a share of GDP. GDP figures have been sourced from the World Bank World Development Indicators (WDI). Figure 5 below compares the UK's R&D expenditure share against those of comparable IEA member countries[16] from 2006 to 2013, in addition to the country-by-country average; we have presented the most recent data available for all countries compared.

We observe that between 2000 and 2013, the UK committed approximately 0.02% of its GDP to R&D expenditure targeting energy efficiency, with a peak of 0.05% in 2010. Whilst this appears to be a very small percentage share, this lies close to the average share of 0.03% across the 29 IEA member countries. Comparing the UK against the other IEA members, Finland – a notable outlier – ranks highest with 0.13% of its GDP in 2013 committed to raising energy efficiency through R&D, with this share having risen from 0.06% in 2005. The International Energy Agency (IEA) note that Finland's energy-intensive industries and cold climate – resulting in high level of energy consumption per capita – makes energy security a significant policy concern. It explains Finland's leadership in energy efficiency R&D, reflecting the Finnish Government's strategy of improving energy security, and progression towards a decarbonised economy.

Figure 5: Energy efficiency R&D expenditure as a percentage of GDP

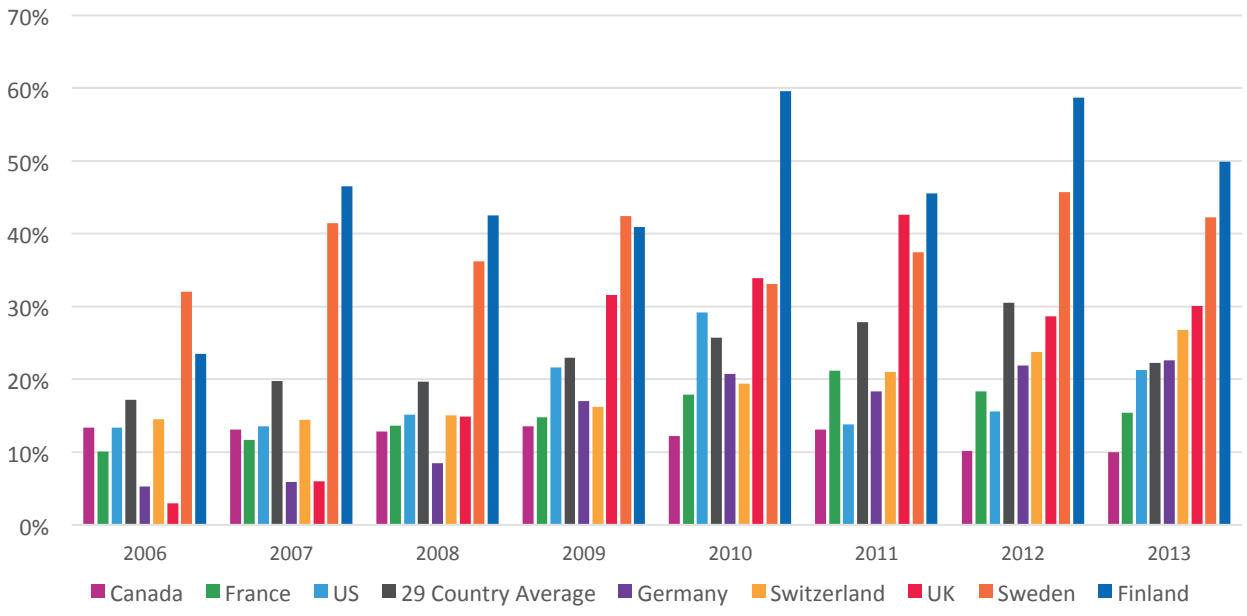
Source: World Energy Coucil



The UK's share is close to that of Germany (0.04%) but lower than those of France (0.06%) and the US (0.04%). Out of the 22 IEA countries with recorded data in 2013, the UK ranked 11th in terms of R&D expenditure committed to energy efficiency, its second-highest ranking since 2010 (7th). The UK share now lies close to the 29-country average of 0.03%, having been below for every year prior since 2000.

The IEA database provides data for all types of R&D expenditure relating to energy, in addition to that of energy efficiency. Other energy R&D expenditure categories recorded by the IEA include power and storage technologies, fossil fuels, renewable energy sources, nuclear power, and hydrogen and fuel cells. Figure 6 below shows the share of total energy R&D expenditure committed to the category of energy efficiency, again with covering a selection of countries.

Figure 6: Total energy efficiency R&D expenditure as a share of total energy R&D expenditure

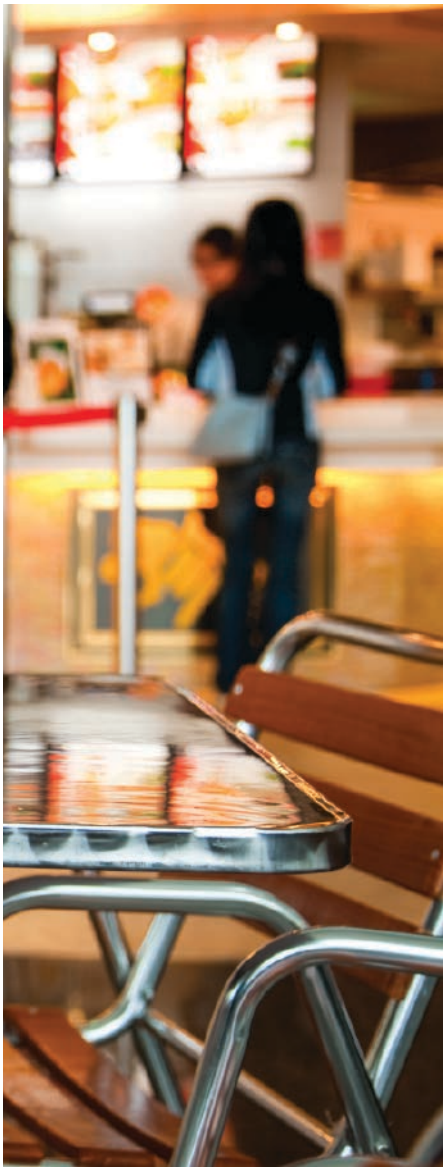


Source: World Energy Coucil

Between 2000 and 2013, the UK committed around 13.8% of its total energy R&D expenditure to energy efficiency. However, this average somewhat masks the increasingly higher shares committed to energy efficiency in recent years. In 2008, around 14.9% of the UK's total energy R&D expenditure was used to promote energy efficiency; in 2009 this share doubled to just fewer than 31.6%, and whilst the share had fallen to 30.1% in 2013, this represents a significant increase on the pre-2009 level. Comparing to the UK to other IEA members, in 2013 only four countries committed a greater share of energy R&D expenditure to energy efficiency: Finland (49.9%), Sweden (42.4%), Austria (44.6%) and the Czech Republic (39.8%). Then UK share of 30.1% in 2013 compares favourably to Germany (23%), the US (21%) and France (15%).

4.2 Energy policy

Here we examine the UK policy record in promoting energy efficiency through behavioural change, by investigating the level of energy savings by different policy measures. Policy information has been sourced from the ODYYSEE MURE Project database.[17] The ODYYSEE database provides information on energy efficiency trends and indicators across Europe countries. MURE contains information on energy efficiency policy measures, including their impact, and covers around 2000 measures.



Setting criteria to identify policy measures

Within the MURE database, policy measures are broken down into the following areas:

- Household
- Tertiary
- Industry
- Transport
- General cross-cutting

MURE has also allowed us to identify policy measures by the following categories:

- Co-operative Measures
- Cross-cutting with sector-specific categories
- Financial
- Fiscal/Tariffs
- Information/Education
- Legislative/Informative
- Legislative/Normative

We have identified "Information, Education or Training" as the policy category which most closely relates to promoting behavioural change (and is henceforth termed as such for the remainder of this section), as it includes the following policy subcategories listed below:

- Detailed energy/electrical bills aiming at energy efficiency improvement
- Information campaigns
- Regional and local information centre on energy efficiency
- Voluntary labelling of buildings and components

We have chosen to only consider policy measures which are described as "Ongoing" – as opposed to "Completed" or "Proposed" – to capture measures which are continuing to affect energy efficiency. In addition, some policy measures have recorded household and industrial impact components. We have separated energy savings into household and industrial components for these measures.

In order to provide a representative comparison of policy measures within and across countries, we have only considered those policy measures for which MURE has recorded an associated impact evaluation. The impact evaluation provides the ex-ante and ex-post estimates for energy savings resulting from each policy, and typically focuses on energy savings achieved by 2010, 2016 and 2020. It is these savings which are examined in the remainder of this section, presented using the measure of Gigawatt hours (GWh).

Policy measures are also categories by their semi-quantitative impact within the MURE database. Impacts are based on quantitative impact evaluations or expert estimates.[18] The categories of impact – Low, Medium or High – relate to the resulting effect on energy consumption or CO2 emissions:

- **Low:** less than 0.1% savings
- **Medium:** Between 0.1% and 0.5% savings
- **High:** Greater than 0.5% savings

Applying the search criteria above yields the following results for UK policy measures in Table 1 below:

Table 1: Identified UK policy measures with estimated semi-quantitative impact

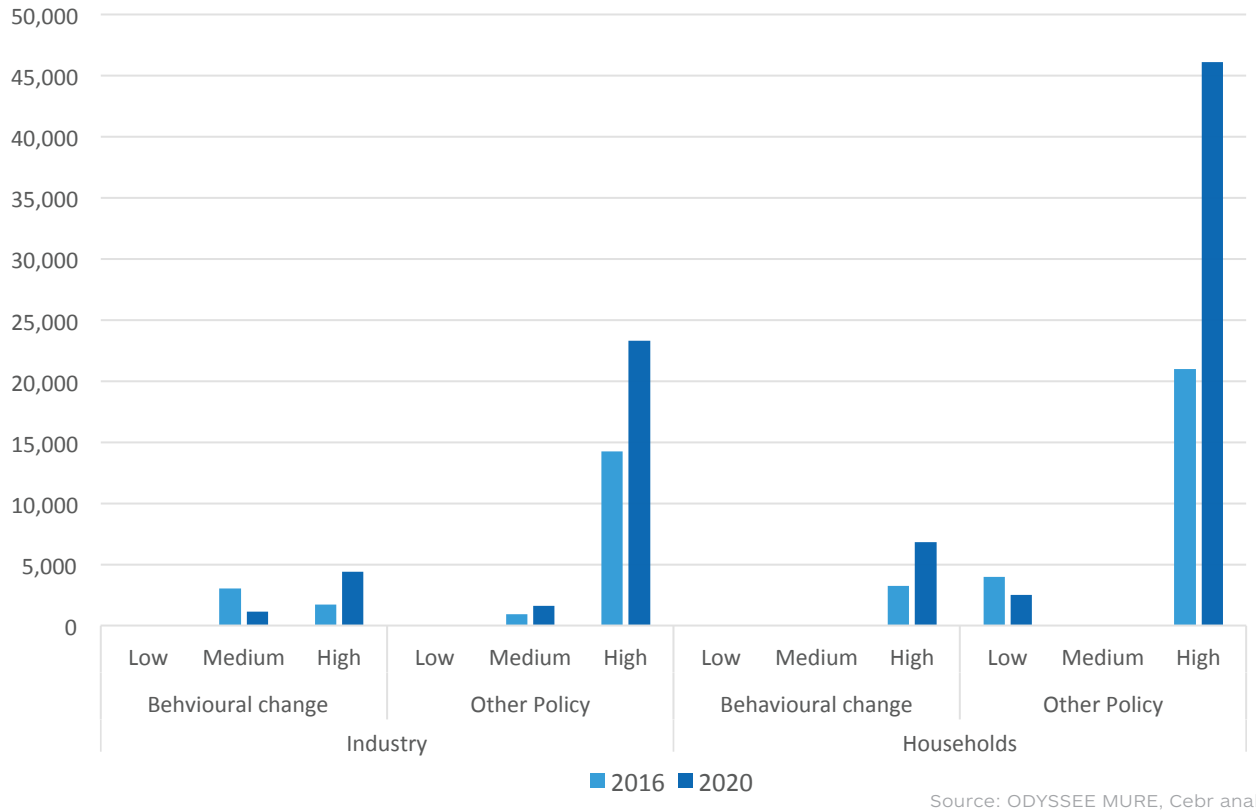
Measure	Category	Type	Impact
Carbon Trust Programmes	Industrial	Information, Education or Training	Medium
UK Smart Metering and billing (non-domestic)	Industrial	Information, Education or Training	High
Climate Change Agreements	Industrial	Co-operative measures, Fiscal/Tariffs	High
EU Emission Trading Scheme	Industrial	New Market-based Instruments	High
Climate Change Levy	Industrial	Cross-cutting	High
Building Regulations (non-domestic)	Industrial	Legislative/Normative	High
Energy Performance Certificates	Industrial	Legislative/Informative	Medium
UK Energy Saving Trust	Household	Information, Education or Training	Medium
UK Smart Metering and billing (households)	Household	Information, Education or Training	High
Zero Carbon buildings	Household	Information, Education or Training	Low
Reduction in VAT rate, Energy Saving Materials	Household	Fiscal/Tariffs	Low
Market Transformation Programme	Household	Legislative/Normative	High
Building Regulations (households)	Household	Legislative/Normative	High
Home Energy Efficiency Programmes (Scotland)	Household	Financial	Low

Source: ODYSSEE MURE, Cebr analysis

UK policy measures and expected energy efficiency savings

Figure 7 below shows the estimated energy savings achieved by policy measures which are currently on-going in the UK, broken down by category and semi-quantitative impact.

Figure 7: Estimated energy savings (GWh) by policy type, category and semi-quantitative impact



Source: ODYSSEE MURE, Cebr analysis

For policy measures affecting industry, we observe that behavioural change measures contribute a minority of expected energy savings in both 2016 and 2020. Of a total of just under 19,900 GWh of expected energy saved by industry in 2016, only 4,800 GWh of savings (around 23.9%) are expected to result from behavioural change policy. By 2020 savings from behavioural change measures are expected to grow to 5,500 GWh, but the proportion of savings in industry will fall in to around 18.1%.

To place these expected energy savings in context, total expected industrial energy savings of 19,900 GWh represents approximately 1.3% of total final energy demand previously forecasted in 2016 by the former DECC.[19] Expected behavioural change policy savings equate to 0.32% in 2016, growing to 0.39% by 2020.

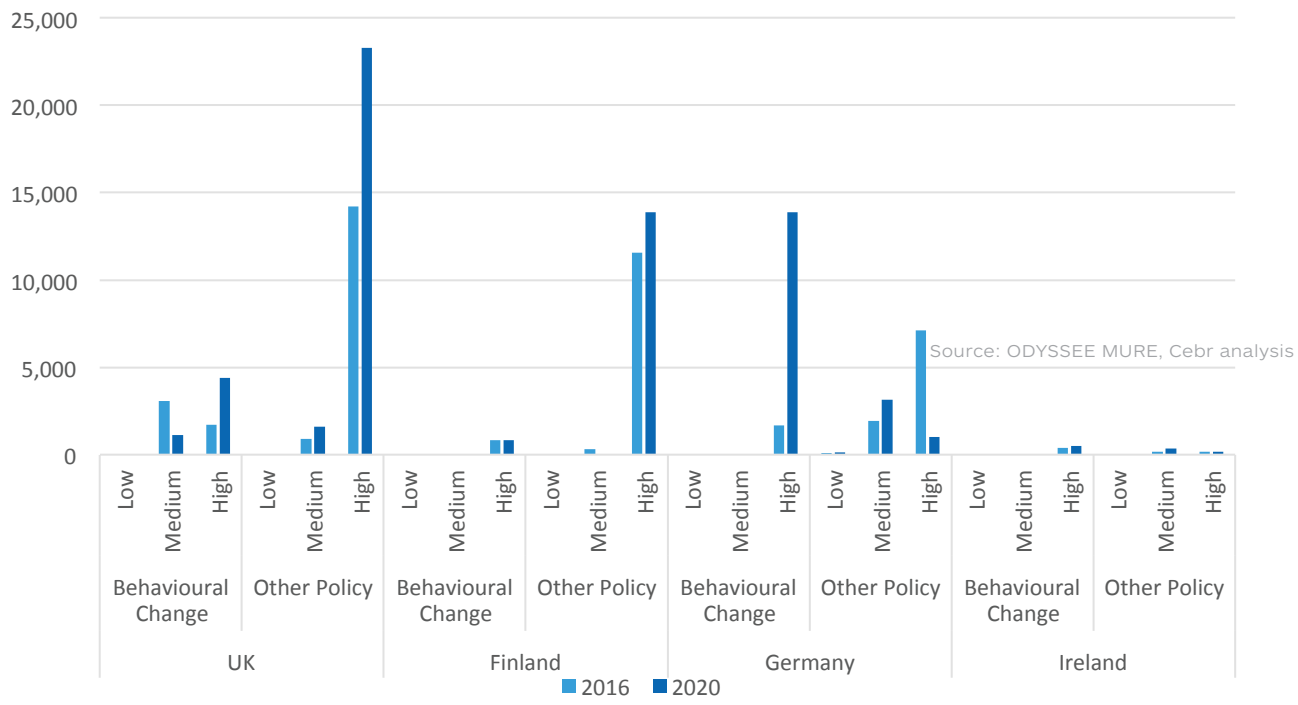
If policy measures affecting industry are compared against those affecting households, a significantly larger amount of savings are expected amongst households. In 2016 the industrial saving of 19,900 GWh compares to 28,200 GWh, of which a higher share of savings result from high impact measures. However, a smaller share of household savings are contributed by behavioural change measures: a total of around 3,200 GWh of energy savings in 2016, rising to 6,800 GWh in 2020.

Comparing UK policies and expected energy savings against those of other European countries

In Figure 8 below we compare the industrial energy savings from on-going policy measures across countries. The countries presented below have been identified as having introduced policies designed to engender behavioural change as defined on page 13 above. Several countries including France, Spain and the Netherlands are currently recorded as having no active policy measures for behavioural change.

Expected behavioural change policy savings equate to 0.32% in 2016, growing to 0.39% by 2020

Figure 8: Expected industrial energy savings (GWh) by country, category and semi-quantitative impact



Source: ODYSSEE MURE, Cebr analysis

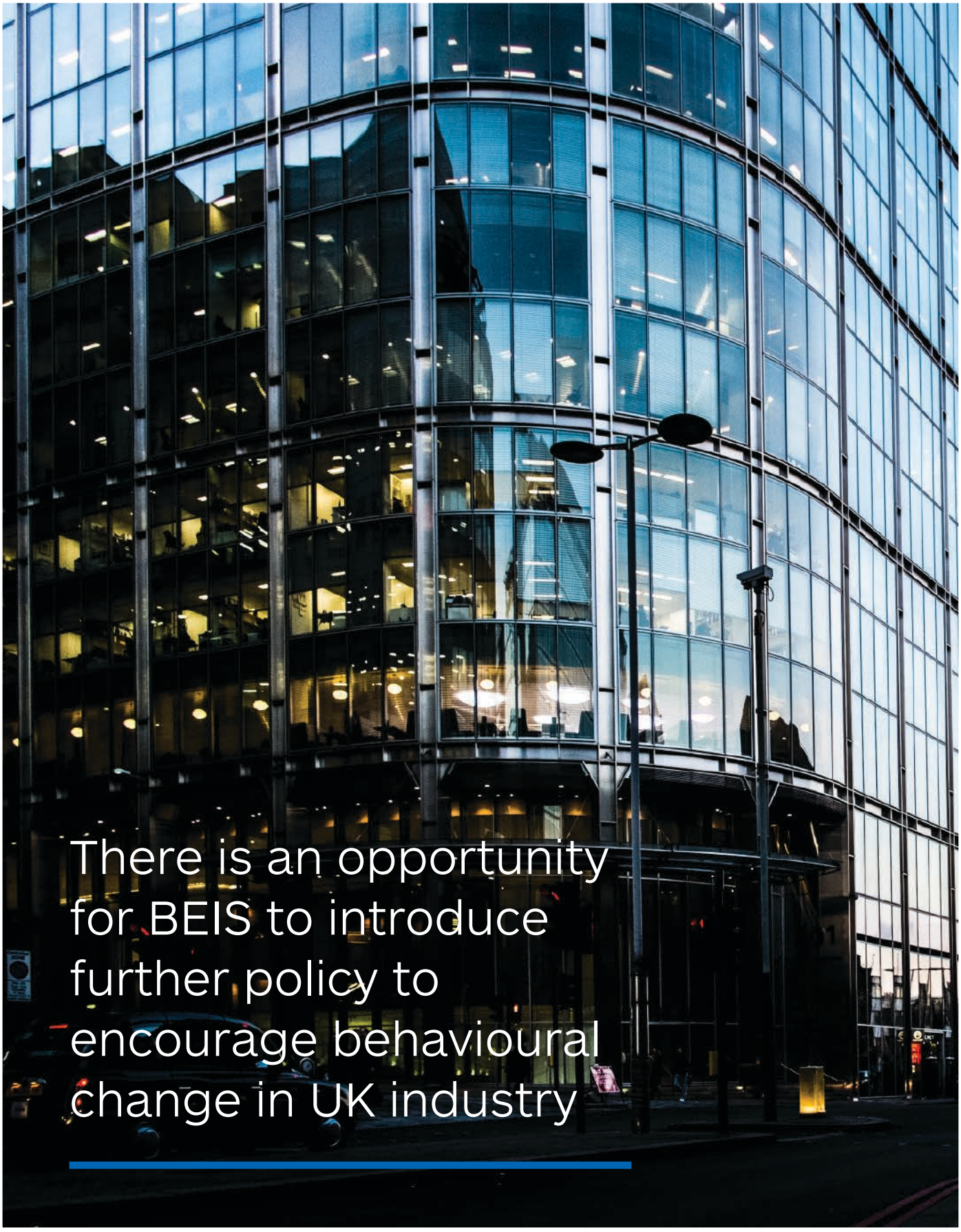
A minority of European countries appear to rely more heavily on policy measures relating to behavioural change in order to achieve energy savings. Whilst Ireland currently has one active policy measure relating to behavioural change (targeting Small Medium Enterprises, or SMEs), this is expected to generate annual energy savings of around 400 GWh in 2016. This represents around 54% of total expected savings from policy measures. Meanwhile, Germany has introduced an Energy Efficiency Networks Initiative, involving energy audits and setting of energy targets across networks of companies. This measure is expected to lead to energy savings of 1,700 GWh in 2016, climbing dramatically to just under 14,000 in 2020, by which point this behavioural change measure will account for around 76.4% of total annual energy savings from policy measures.
The UK's position is closer to Finland, where we estimate that a total of just over 12,700 GWh of energy savings are expected in 2016, with this expected saving rising to just over 14,700 GWh by 2020. However, only around 6.6% of total expected savings relate to policy measures designed to promote behavioural change. This share is expected to fall to 5.7% by 2020. The dominance of other policy types used to reduce energy use has been noted by the ADEME through the ODYYSEE MURE project. In their 2015 analysis[20] ADEME note that *"financial measures are the by far dominating measure type in industry in almost all EU Member States."*

In the next section we examine the evidence literature on the contribution that behavioural change could make to raising energy efficiency levels across businesses, and the other associated benefits for business competitiveness, financial savings and staff engagement. We use this additional evidence to further support the case for BEIS to place greater focus on energy efficiency amongst businesses.

Summary

Our analysis shows that:

- The UK has devoted a greater share of its GDP to energy efficiency R&D expenditure in recent years. Whilst the UK's R&D expenditure on energy efficiency lies close to the average of countries considered in the analysis, it has approximately trebled from an estimated 0.01% of GDP in 2000 to 0.03% in 2013.
- Since 2008 the UK has also committed significantly higher proportions of its energy R&D expenditure to energy efficiency over other forms of R&D (such as nuclear power), suggesting a marked change in R&D policy amongst UK businesses and the Government.
- Whilst the UK position in R&D expenditure has significantly improved, there is a sizeable difference between the energy savings expected to result from behavioural change policy versus other types of policy (such as financial or tariff measures). The UK does not appear to be alone in this regard; few other countries have active behavioural change policies targeting industry.
- At around 5,500 GWh of energy saved, behavioural change measures account for only 18% of expected energy savings in UK industry by 2020. Behavioural change measures are expected to have a larger impact amongst households by this point, at around 6,800 GWh. There is potential scope for additional policy measures to increase energy savings that could be achieved through behavioural change – particularly in industry.
- Cebr and nBS therefore argue that there may be an opportunity for the new Department for Business, Energy and Industrial Strategy (BEIS) to introduce further policy to encourage behavioural change in UK industry. This should be part of a broader refocus on energy efficiency and engaging with businesses to achieve this.


There is an opportunity for BEIS to introduce further policy to encourage behavioural change in UK industry

5.0 Review of the evidence on behavioural change

In this section we provide a non-exhaustive review of the literature and evidence concerning the role of behavioural change in promoting energy efficiency.

Headlines

From our review of the existing evidence on behavioural change, we observe that:

- DECC formerly identified that interventions to change behaviour can deliver significant energy savings. The department (and others) has also previously highlighted **that the most success could be achieved by combining technology improvements with behavioural change.**
- UK businesses could save a sizeable share of their energy bills through changing behaviours. The European Energy Agency (EEA) has **estimated that potential energy savings can range from 2% to 20% depending on the measured used.** The Carbon Trust has separately stated that a 20% increase in energy efficiency is achievable across all business sectors.
- Other evidence from an array of sources highlight the **significant opportunity for UK businesses – particularly larger businesses – to achieve savings through behavioural change.** The Carbon Trust previously identified a £300 million opportunity; the Confederation of British Industry has also estimated that better energy management could yield a 15% reduction in large business' energy bills.
- Within larger businesses, offices may hold the greatest potential for action to achieve significant savings. **Increasing the "visibility" of energy and assigning strategic value to energy efficiency may also be ways in which businesses can seek to promote behavioural change.**

5.1 Behavioural change and energy savings

There is evidence to suggest a positive link between behavioural change and energy savings. The former Department of Energy and Climate Change (DECC) previously examined the factors influencing energy behaviours[21] and has provided an overview of existing research evidence relating to energy efficiency behaviours – particularly for large businesses. In their report, DECC commented that there is significant potential to use insights from behavioural or social psychology to design interventions to influence behaviour. As a result, it is suggested that *"interventions which influence occupant behaviour can deliver very significant energy savings in some settings. For example, our evidence base includes studies showing between 6 and 18% savings in university office buildings."*

The European Environment Agency (EEA) has also assessed the role of behavioural change in promoting energy efficiency.[22] The EEA emphasise that more may need to be done by senior decision makers in businesses to engage their employees; for initiatives are normally delivered at the organisational or sub-organisational level, there is no typically direct link to personal wealth of the individual employees. Changing energy efficiency behaviours may therefore need to rely on corporate and social responsibility objectives and reinforcing societal norms.

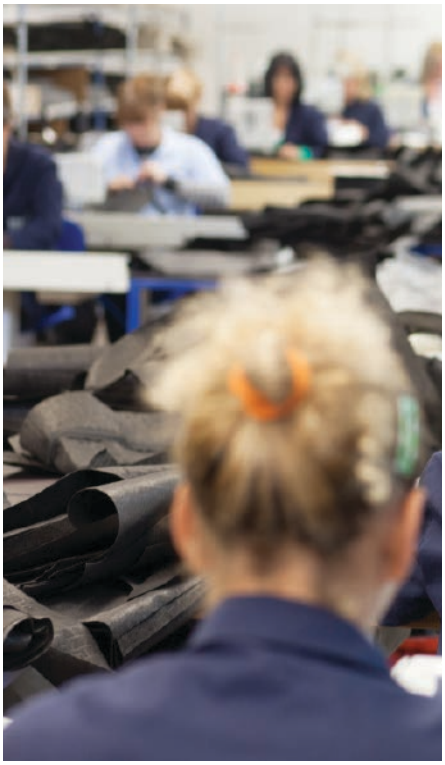
The EEA conducted their own review of academic literature to identify the range of potential energy savings that could be achieved by businesses through measures targeting behaviour. These measures include feedback, energy audits and community-based initiatives. "Feedback" is defined here as the frame of reference by which consumer and employees can determine whether their energy usage is excessive or partially unnecessary. "Direct feedback" relates to information conveyed directly to consumers through media such as their computers or smart meters. "Indirect feedback" relates to information conveying comparative energy use, provided for example as part of billing. Table 2 below shows the range of savings which the EEA estimate could be achieved through behavioural change.

Table 2: Range of potential energy savings from behavioural change interventions

Behavioural opportunity	Range of potential energy savings
Feedback	5 – 15%
Direct feedback	5 – 15%
Indirect feedback	2 – 10%
Feedback and target setting	5 – 15%
Energy audits	5 – 20%
Community-based initiatives	5 – 20%
Combination of interventions	5 – 20%

Source: EEA

The EEA also comment on the potential "rebound effect" associated with greater energy efficiency resulting from behavioural change. The rebound effect is an observed phenomenon in which the full potential from the introduction of energy efficiency measures is not reached due to behavioural change *increasing* energy use, thereby reducing or even minimising the gains from reduced energy usage. In energy management terms, the improved energy saving disappears over time and the consumed energy returns to baseline after a certain period following the intervention. Whilst the EEA's research suggests that the rebound effect is less than 50 % for the household sector and much less for the business sector, quantifying the effect remains challenging. So whilst the rebound effect should not justify delaying investments in energy efficiency and behavioural change methods, the potential savings presented in Table 2 above may represent upper limits.



5.2 Combining technological changes with behavioural change

Whilst technological improvements are important to promote energy efficiency, DECC also highlighted the most successful strategies to promote energy efficiency *"use a combination of technology change, feedback to users and norm activation"* – suggesting that technology change is only part of the solution. In combining these methods, there is increased visibility of energy consumption amongst employees, providing tangible evidence of the organisation's commitment to improved environmental performance. These mechanisms operate by making energy use visible (through feedback) and by presenting its efficient use as socially desirable (using "key influencers") and by using the visible investment in new technology as emblematic of cultural change within the organisation. DECC cite one study of the use of feedback and peer education (energy champions) in academic office buildings, where interventions resulted in a 7% and 4% reduction in energy use respectively.

ADEME[23] also support the combination of a mix of policies – including behavioural change – as a means to promote the uptake of energy efficient measures in businesses. They point out that *"a suitable policy mix addressing energy efficiency in industry should break down the most important barriers which hinder the uptake of energy efficiency measures in companies... and make use of the driving forces which facilitate the implantation of energy efficiency measures (e.g. positive image of energy efficiency, motivated employees)."*

5.3 Behavioural change and the opportunity for businesses

Further evidence from Government and third parties indicates that there is a clear opportunity for UK businesses to make substantial savings through behavioural change.

The former DECC previously cited studies which suggest that the appointment of a dedicated energy or environmental manager (more likely to occur in larger businesses) is strongly associated with greater likelihood of having an energy or environmental strategy in place. Moreover, the closer the energy manager is in the business' hierarchy to the CEO, the more energy management takes place. However, the appointment of energy managers in large businesses is less frequent than expected, suggesting that managers in larger companies are generally not attaching strategic value to energy use and efficiency. DECC also identified several behavioural-related implications and recommendations from their research:

- Interventions to occupant behaviour hold significant potential both in directly creating savings and indirectly via changing organisational culture and hence decision-making.
- Individuals and groups within larger businesses are often overlooked by Government policy.
- Energy efficiency is much more likely to become a strategic objective for businesses when energy consumption becomes salient. This means instituting monitoring and reporting practices and combining energy efficiency messaging with a broader efficiency agenda.
- When energy efficiency is targeted as having strategic value, access to finance becomes easier, particularly for larger businesses.

Altan[24] analyses the responses of 23 university energy managers to a questionnaire about their energy efficiency interventions, finding that non-technical initiatives achieved significant energy savings at a modest cost. For example, training energy champions was implemented by a third of respondents, all of which reported that it cost less than £1,000, with two thirds reporting it a success achieving energy savings of up to 18%. Cox et al.[25] find that there is *"a clear view from employers that cutting carbon emissions has significant knock-on benefits, including building organisational reputation, being seen as a pro-environmental brand, improving sales/customer retention, recruiting and retaining high quality staff, reducing operating costs and meeting regulatory requirements."*

The Confederation of British Industry (CBI)[26] has identified a large amount of untapped potential for UK businesses to increase their energy efficiency. The CBI suggests that both technological and behavioural changes continue to be overlooked by many businesses, pointing to estimates showing that some businesses are collectively paying £1.6 billion more than they need to on their energy bills due to a lack of onsite energy efficiency. Lack of energy awareness at all levels is cited as a common challenge and reason for this wastage. Large businesses in particular could benefit: CBI's research suggests that better energy management could result in a 15% reduction in large business' energy bills.

The CBI stress that more needs to be done to promote awareness amongst employees at all levels: *"Even where energy efficiency has been prioritised at the top, awareness is sometimes only found amongst the staff working directly on energy efficiency projects, and even then, staff can lack an understanding of the technologies and services available to help improve efficiency… more broadly, without company-wide understanding, basic behavioural changes to cut down on energy use, such as simply switching off lights and computers and using technology and processes properly, will also be missed."*

The Trades Union Congress (TUC)[27] cites one survey of 279 business customers that showed that although around half of those surveyed had the ability to take energy conservation actions, a smaller percentage of the respondents actually performed the actions. The TUC stress that the key to supporting behavioural change is embedding knowledge of how to increase energy efficiency across society.

Similarly, the Institute of Directors (IoD)[28] has previously stated that 20% improvement in energy efficiency was "achievable", citing that SMEs were forgoing energy savings of up to £1 billion. The IoD also pointed to the importance of behaviours, stating that *"at the heart of any energy efficiency endeavour are people and influencing the energy behaviours of an organisation's people must form a central part of any plan to reduce energy use."* Through a survey, the IoD found that 30% of those organisations which did address energy use also reported energy savings on average of 8%.

The Association for the Conservation of Energy (ACE)[29] argue that offices offer the greatest potential for action to achieve significant savings, and "action by a small group of large stakeholders could change the market significantly", whilst pointing to increasing amounts of evidence of a significant positive correlation between productivity and energy efficiency. In a separate report[30] ACE note that when it comes to taking action to promote energy efficiency, on-going corporate understanding is key to energy awareness – involving partnership with an adviser – and is easiest for larger business tenants and owner-occupiers to achieve. Turning to recommendations, ACE propose greater awareness of energy consultant services, making better use of existing information on the costs of energy efficient buildings, and selling the benefits of energy efficiency more effectively to professionals operating in commercial property.

The UK Carbon Trust has also identified behavioural change as an opportunity for businesses to make substantial energy savings. In 2013 the Carbon Trust estimated that there was a "£300 million opportunity"[31] of business savings that could be achieved through employees adopting "greener" behaviours.

Comparatively small but readily available changes could be made which cumulatively would have a large impact on costs and carbon emissions; however, sound behavioural psychology and marketing expertise would be necessary to fully exploit this opportunity. It is estimated that *"with an investment of between 1 - 2% of energy spend in an effective employee engagement campaign, many organisations can save up to 10% on energy costs."* Through a survey of 1,135 UK employees in December 2013, the Carbon Trust also found that:

- Very few employers were taking action to engage their workforce. Only 23% of employees had been asked to help save energy at work by their manager, and just 13% claim that they had been rewarded by their employers for saving energy.
- There was a significant gap between being willing to take action in principle and actually taking it. 96% were willing to regularly turn off lights in unoccupied rooms or areas, but only 52% actually were. 74% were willing to replace a meeting with a video conversation, but only 17% were doing so.
- Just 22% of employees were confident that they knew what actions to take to save energy at work, and just 16% were sure that they have the authority to do it.

The Carbon Trust has also conducted analysis on the direct benefits that could be elicited from behavioural change. It estimates from its analysis of energy efficiency measures identified in over 2,000 organisations that there is an average internal rate of return of over 40%, in comparison to 10 - 15% returns from 'typical' business investments.

with an investment of between 1 - 2% of energy spend in an effective employee engagement campaign, many organisations can save up to 10% on energy costs.

5.4 Existing focus on behavioural change, households and SMEs

Other analysis previously commissioned for or produced by DECC focusing on the benefits of behavioural change heavily emphasises the benefits for households and smaller businesses.

In a report for DECC, Cambridge Architectural Research[32] examined the potential energy savings that could be achieved by households adopting 45 'behaviours' defined by DECC, producing estimates for savings resulting from different behaviours (such as reducing thermostat temperatures, installing more efficient infrastructure in homes and delaying heating use). Another example of behavioural change recommendations focusing on households is a recent note produced by the Parliamentary Office of Science and Technology.[33] Energy efficiency is often viewed as "invisible" (thereby emphasising the importance of feedback, for example as provided by smart meters) and given a low priority, measures to promote efficiency are perceived as expensive, and social norms often prevent implementation.

This note highlights how encouraging behavioural change amongst the UK public could contribute to the UK's energy policy goals of energy security and affordability.

For smaller businesses, DECC previously published a SME Energy Efficiency Guide[34] which outlines the various ways in which SMEs can promote energy efficiency and lower their energy bills. DECC identified that the promotion of energy efficiency – even through simple changes in behaviour amongst employees – can result in an array of benefits for small businesses. These benefits include increased competitiveness and profitability, higher staff retention and more comfortable working environments, improved cash flow and increase resilience against energy price increases and price volatility expected by DECC over the next five years. DECC estimate that *"for a company with a five percent profit margin over 3 years, a £500-a-year saving from energy efficiency makes the same profit as £30,000 of extra sales."*

more successful initiatives to raise energy efficiency in businesses will combine technological change with measures to engender behavioural change.

Summary

We have conducted a non-exhaustive review of the existing evidence on behavioural change and its potential to help save energy. In summary, it is found that:

- There are likely to be substantial gains to be made by businesses through behavioural change, both in terms of energy saved and reductions in costs. Potential savings will vary depending on the measures implemented and the success of management in engaging employees.
- There is evidence to suggest that more successful initiatives to raise energy efficiency in businesses will combine technological change with measures to engender behavioural change. There is scope within businesses to encourage employees to save energy, institute energy management and place strategic value on energy saving and efficiency.
- In terms of the Government engaging with energy users and promoting behavioural change, the focus so far appears to have been more on Small Medium Enterprises (SMEs) and households. Focus on the latter mirrors the significant reductions in household energy intensity identified earlier in this report.
- The combination of this evidence suggests that there is an opportunity for the new Department for Business, Energy and Industrial Strategy (BEIS) to target behavioural change amongst larger businesses, in the same way that the former DECC sought to encourage behavioural change amongst Small Medium Enterprises (SMEs) through the SME Energy Efficiency Guide.

6.0 Business savings from behavioural change

Having gathered evidence on the potential savings for large businesses from behavioural change, in this section we estimate the amount of savings that could be achieved by UK businesses through successful adoption and implementation of behavioural change. We firstly explain the methodology by which this analysis draws on, before discussing the resulting estimates. We then estimate the potential savings that could be made by large UK businesses versus small and medium-sized businesses.

nBS has previously estimated that UK businesses could make significant savings through energy behaviour change, with each company potentially saving between 3 to 15 per cent[35] – equating to an average saving of 9 per cent. Separately, the Carbon Trust estimates that a "comprehensive and well-run behavioural change campaign" can save a business around 10% of its energy bill. We have used these existing estimates, in addition to the evidence discussed in the Section 5, as a framework and guide for the analysis.

Headlines

From our analysis of potential energy savings amongst UK businesses, we find that:

- There are **several different behavioural change measures which large businesses could implement in order to achieve significant business savings.** Behavioural change measures range from smaller measures such as:
  - Better use of heating equipment, such as encouraging employees to reduce office temperature settings
  - More efficient use of mobile phone changers
  - Turning off audio visual equipment when not in use

  Through to **larger scale behavioural change measures** such as:
  - Encouraging switch-off campaigns and more efficient use of office equipment, such as printers, faxes and photocopiers
  - More efficient use of computers and monitors
- We have used two approaches to estimate potential business savings, firstly drawing upon the number of employees within businesses annual energy bills faced by businesses and secondly annual energy bills faced by businesses. Both approaches yield similar estimates for potential business energy savings, and suggest that **savings could be worth hundreds of millions of pounds each year.**
- Applying the first approach, we estimate that there are between £470 million and £860 million of potential business savings that could be achieved through behavioural change, with a mid-range estimate of £600 million. This equates to **just under 6000 Gigawatt hours (GWh) saved.**
- The majority of these potential savings are concentrated disproportionately amongst larger businesses. We estimate that large businesses could achieve between £190 million and £460 million of potential business savings, **with a mid-range estimate of £270 million, or around 2,700 GWh.**

6.1 Overview of methodology

Approaches to estimate potential energy savings

Our analysis features two approaches to estimate the total potential savings that UK businesses could achieve through behavioural change. Further information on the methodology applied can be found in Annex A of this report.

- The first approach involved the estimation of potential savings by the number of employees recorded as working in small, medium and large businesses across the various industrial sectors. For example, the Carbon Trust estimate that a business employing 50 people could save £27 a year in energy costs by setting up a switch-off campaign for office equipment such as printers, faxes and photocopiers. With concentrations of firms of different sizes varying across different sectors and with potential savings linked to the number of employees, this represents a "bottom-up" approach.

- The second approach involved the estimation of the annual energy bills faced by small, medium and large businesses, based on their average gas and electricity usage and the recorded price per unit of gas and electricity. For example, the Carbon Trust estimate that a business with an annual energy bill of £1,000 could save £97 annually through undertaking a switch-off campaign for computers and monitors.

In both approaches we have then expressed the total estimated savings as a percentage of total electricity use by sector, to compare against the other existing evidence on behavioural change. This then acts as a "sense-check" against existing findings discussed in Section 5 earlier in this report.

We acknowledge that using the number of employees recorded in businesses is one of several ways in which business size can be measured (alongside turnover, capital investment, market share or capitalisation). It is not always exact method of measuring business size but in this context has enabled us to provide a UK-level extrapolation of the savings that could result from widespread behavioural change amongst businesses. However, the number of employees is the most appropriate measure to use as behavioural change manifests through employees.

It is difficult to ascertain what behavioural change measures businesses may already have introduced by UK businesses; some may have already achievable sizeable gains through internal energy efficiency campaigns and assign strategic value to energy. The results presented in this report therefore represent an approximation – an opportunity that could be realised through widespread implementation of behavioural change.

Data Sources

For both approaches, we have utilised the Business Population Estimates (BPE) as previously provided by the former Department for Business, Innovation and Skills (BIS), which yield information on the number of companies disaggregated by size, sector and region.

For the first approach, we have utilised the Carbon Trust's "Empower savings calculator"[36], which provides estimates for potential savings from employee engagement in energy efficiency. The Empower calculator can be calibrated using either a business' annual energy bill or the number of its employees, in order to yield the energy bill savings that could be gained from promoting energy efficiency, either through behavioural change or by introducing innovations such as smart meters.

Through using the BPE, the first approach enables us to examine savings across different industrial sectors, whereas the second approach is based on all-encompassing pricing data.

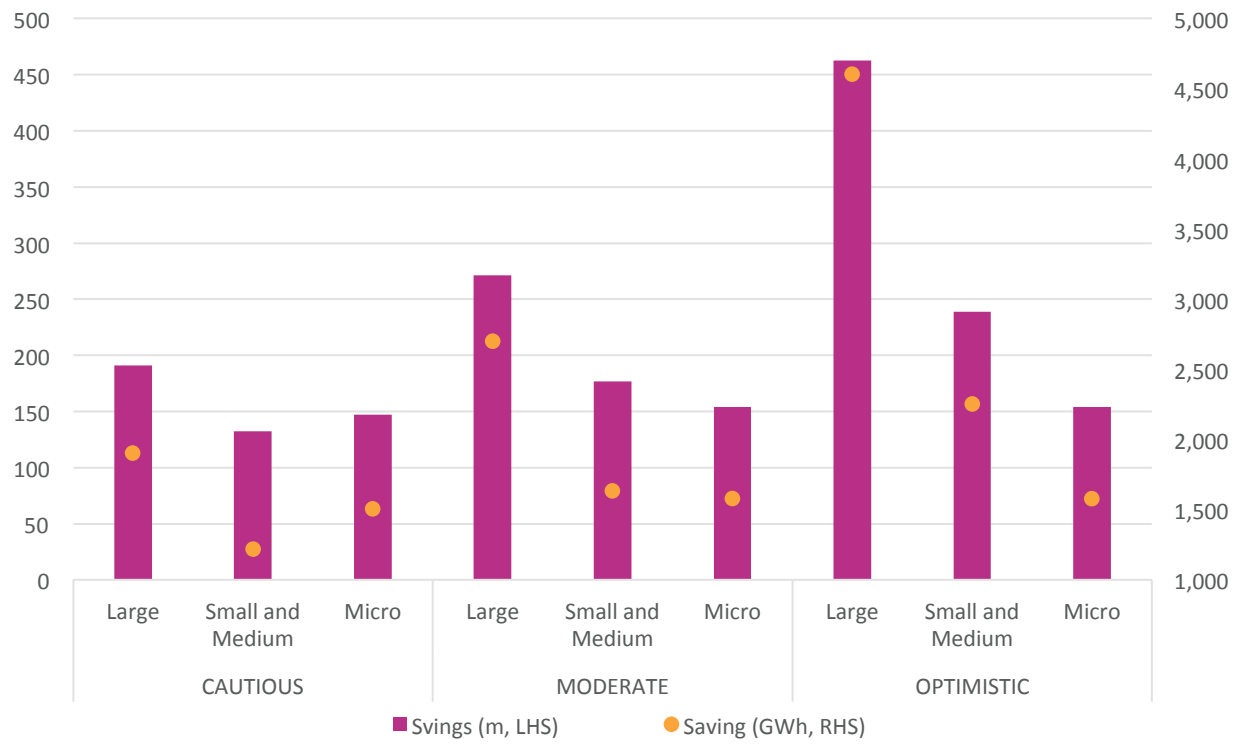
6.2 Results

Here we detail the results of the potential business savings analysis through both approaches. Savings are expressed in terms of the reduction in business energy bills and in Gigawatt hours (GWh) of energy used by businesses.

Approach I

Figure 9 below shows the potential business savings from behavioural change as estimated using the first approach described above.

Figure 9: Estimated potential business savings by scenario and business size, using Approach I



Source: ODYSSEE MURE, Cebr analysis

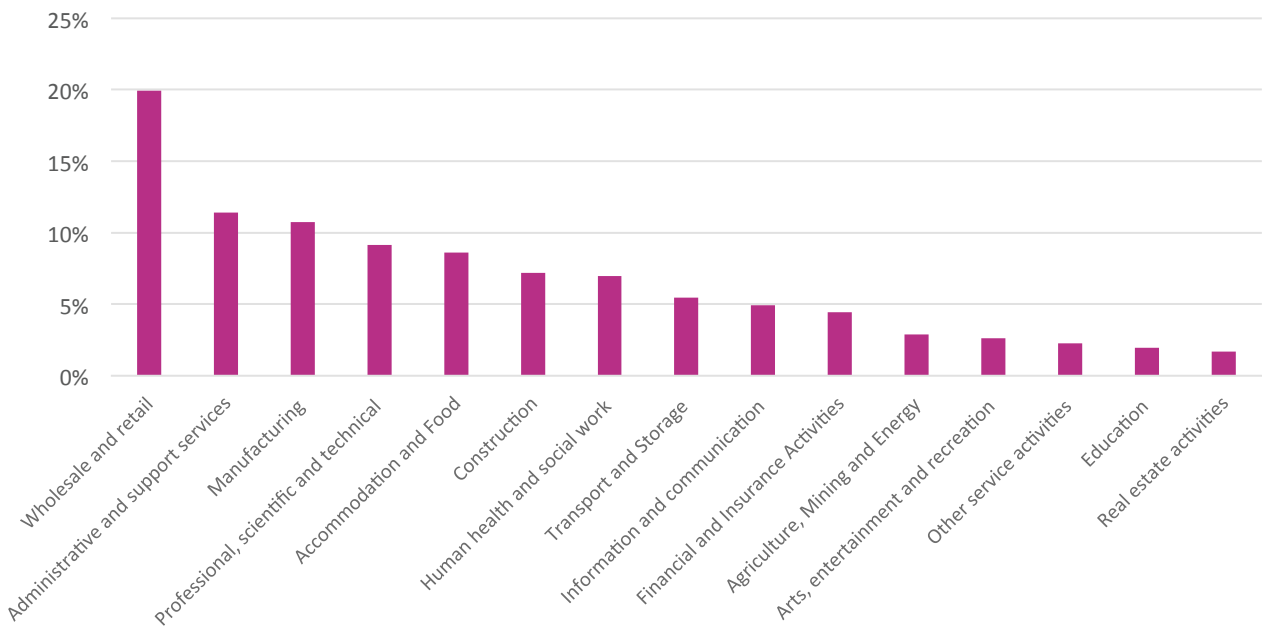
Under our cautious scenario, there are around £470 million of potential savings that could be achieved through behavioural change, equating to 4,735 Gigawatt hours (GWh) of electricity saved, with approximately £190m (41%) of these savings attributable to large businesses. Savings from micro businesses (around £150 million) are slightly higher than small and medium-sized businesses (£130 million) due to the vastly larger number of these businesses in the population.

Under the moderate scenario, the potential savings from large businesses climbs to £270 million, or around 45% of the total potential business savings. This is attributable to the wider range of behavioural change measures that are assumed to be implemented. Under our most optimistic scenario, there are just under £860 million of potential savings that could be achieved, equating to around 8,400 GWh of electricity saved, with just over £460 million of savings achieved by large businesses.

So we estimate that in each scenario, a disproportionately high share of potential savings could be achieved by large businesses. This is despite there being only around 7,000 such enterprises in 2015 as recorded in the Business Population Estimates (in comparison to a total of just under 5,400,000 businesses in total).

Figure 10 below breaks down the £600 million of potential business savings estimated under the moderate scenario by industrial sector.

Figure 10: Share of estimated potential business savings, moderate scenario, by industrial sector



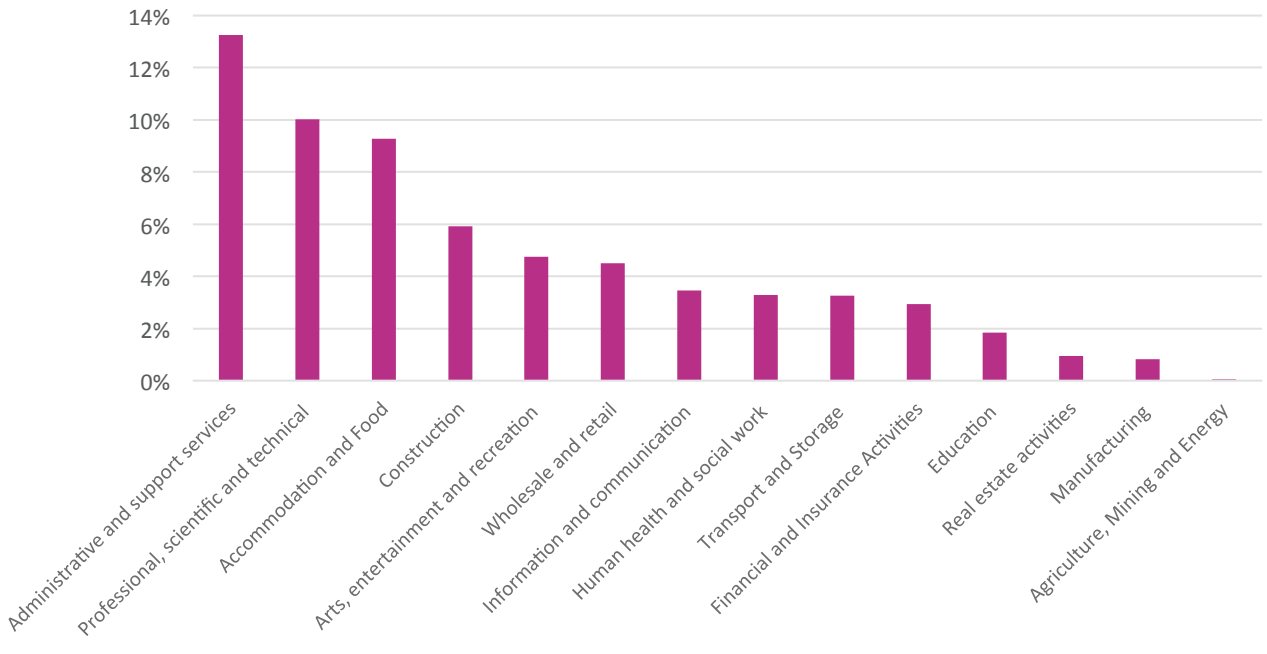
Source: DECC, BIS, Carbon Trust, Cebr analysis

We observe that the largest shares of the potential savings could be achieved in the Wholesale and retail (19.9%), Administrative and Support (11.4%), and Manufacturing (10.8%) sectors. In order to demonstrate the relative size of these potential large business savings, it is useful to express them as a proportion of total energy purchases from businesses. In 2013 businesses consumed just under £52 billion of electricity in order to produce goods and services.[37] Combining this information with the potential savings amounts described above, under the moderate scenario we estimate that behavioural change-related energy savings could reduce overall business energy purchases by around 1.2%. This saving increases to 1.6% if the optimistic scenario is assumed.

In Figure 11 below we have expressed total potential energy savings by sector as a share of total energy purchases by sector, again using the moderate scenario described above. Total energy purchases by sector are proxied for by total intermediate consumption of goods and services from the energy sector, which are taken from the ONS Supply Use tables.[38] This data can then be used to approximate the potential savings by sector resulting from behavioural change.

We observe from Figure 11 that the largest potential savings as a proportion of total electricity purchases could be achieved in the Accommodation and Food (9.3%), Professional Scientific and Technical (10.0%), and Administrative and Support Services (13.2%) sectors. Whilst these potential gains are quite large in comparison to some sectors, such as Financial and Insurance (2.9%) and Manufacturing (0.8%) they remain within the ranges suggested by the literature from Section 5.

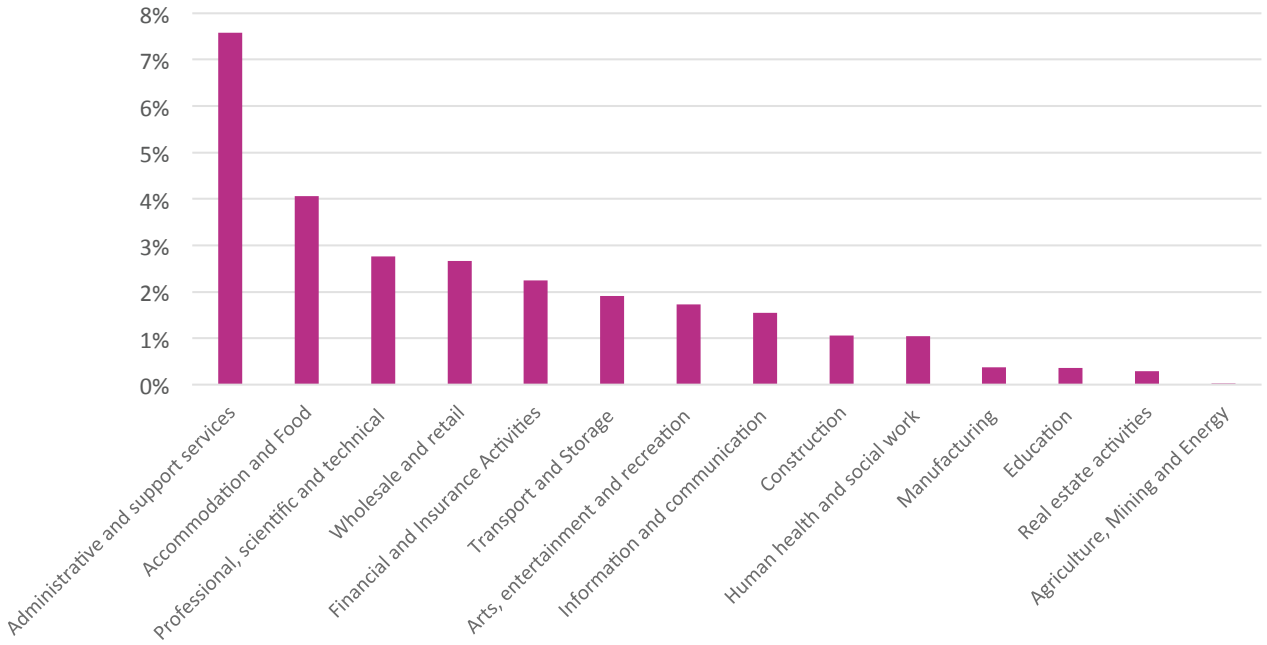
Figure 11: Potential total business savings as a proportion of total UK intermediate electricity consumption, using the moderate scenario



Source: DECC, BIS, ONS, Carbon Trust, Cebr analysis

In Figure 12 below, we have expressed total potential energy savings for large businesses, in order to provide a comparison against the results shown in Figure 11. Potential savings amongst large businesses are again greatest in Accommodation and Food (4.1%), Professional Scientific and Technical (2.8%), and Administrative and Support Services (7.6%).

Figure 12: Potential large business savings as a proportion of total UK intermediate electricity consumption, using the moderate scenario



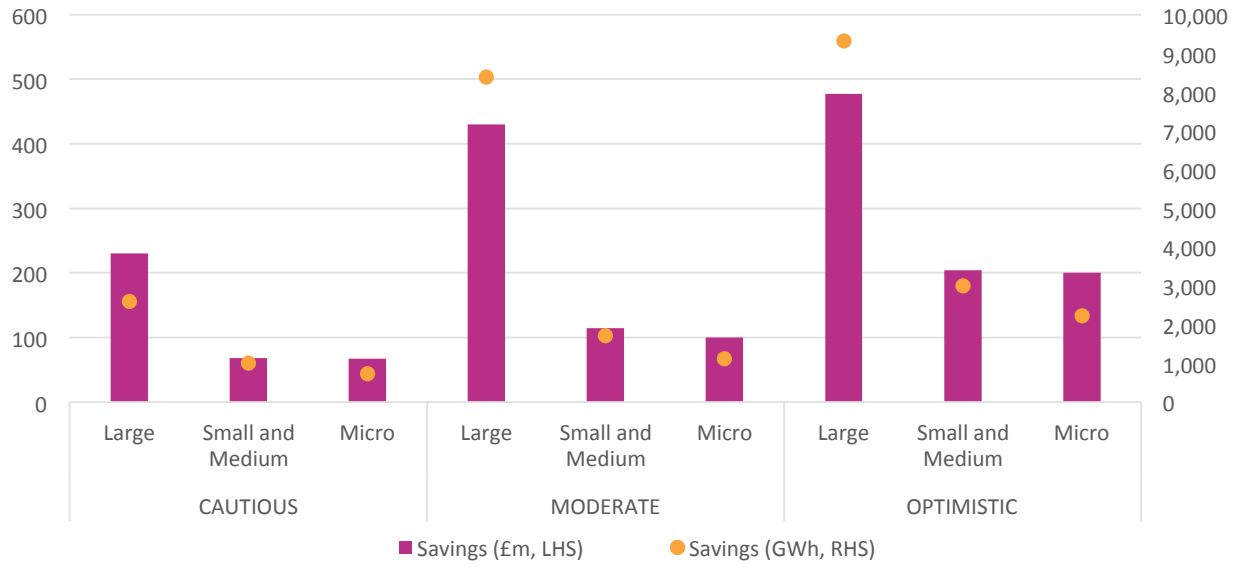
Source: DECC, BIS, ONS, Carbon Trust, Cebr analysis

Figure 13 shows the potential business savings from behavioural change as estimated using the second approach described above.

Under our cautious scenario, we estimate that there are just under £370 million of potential savings that could be achieved through behavioural change, equating to just over 4,300 Gigawatt hours (GWh) of total electricity and gas saved. Once again, potential savings are heavily and disproportionately concentrated amongst large businesses at £230 million. In contrast, under the optimistic scenario, around £880 million in potential savings could be achieved, equating to just over 14,600 GWh of electricity, with £480 million (or just over 54%) of savings that could be achieved by large businesses.

Using the results of both approaches and the moderate scenario, we estimate that between the potential savings that could be achieved by businesses through successfully implementing behavioural change ranges between £600 million and £700 million. For large businesses, the potential savings between £270 million and £430 million. Due to the granular level of data available to Approach I, we advocate the use of savings estimates taken from this approach, as they are likely to hold a greater degree of accuracy. Under our most optimistic scenario – in which various behavioural change measures are successfully implemented – potential large business savings are around £470 million.

Figure 13: Estimated potential business savings by scenario using Approach II



Source: DECC, BIS, Carbon Trust, Cebr analysis

Summary

Our analysis of potential energy savings amongst UK businesses shows that:

- Behavioural change represents a major savings opportunity for UK businesses, and large businesses in particular. Cebr and nBS believe that the combination of these savings estimates with existing evidence on the benefits of behavioural change means that there is therefore an opportunity for the new Department for Business, Energy and Industrial Strategy to promote behavioural change across large businesses.
- Whilst it is difficult to establish what businesses have already done in the way of behavioural change measures, both approaches we have taken in our analysis suggest that the potential savings could be worth hundreds of millions of pounds each year. Potential savings estimate lie within the region suggested by the academic literature.
- Further analysis may wish to further examine billing for businesses in particular sectors, and also identify how much businesses have already achieved in terms of energy efficiency.
- These potential savings resulting from behavioural changes would not just benefit the bottom line. Other benefits would be greater energy security, a more motivated workforce, and a positive impact on the UK balance of payments. The latter is likely to be a particularly pertinent benefit given that the United Kingdom will leave the European Union.
- Cebr's potential savings estimates exceed that of the previous Carbon Trust estimate of £300 million, but lie lower than the £1 billion previously estimated by nBS, but our analysis may be an underestimate and we have not directly used energy bill data from large businesses as the basis for the analysis. Further analysis may seek to use information from smart meters or other sources to estimate potential savings.

Concluding remarks

In this report we have examined the case for behavioural change and the role it could play in achieving major savings for UK businesses – particularly for large businesses.

The UK is a relatively energy efficient country based on its relatively low levels of energy intensity; its performance based on recent trends compares favourably to that of other European countries. However, the UK appears to have performed more strongly in raising energy efficiency amongst households in comparison to industry, whilst improvements in industrial energy efficiency have slowed since 2007. So there is scope to achieve further improvements in energy efficiency – particularly in industry, with the promotion of behavioural change as a means to achieve this.

We have examined the recent policy environment relating to energy efficiency, focusing on two particular aspects of energy efficiency policy: Research and Development (R&D) expenditure on energy efficiency, and policy measures designed to engender behavioural change. In terms of the share of Gross Domestic Product (GDP) devoted to R&D expenditure in energy efficiency, the UK's share now lies close to the average of comparable countries. In terms of the share of all R&D expenditure relating to energy which is devoted to energy efficiency, the UK now ranks considerably more highly now than in 2006. However, whilst R&D expenditure has increased, the UK's record in wider policy measures is more mixed, despite it being one of the few countries with active policy measures targeting behavioural change. Policy measures targeting behavioural change in industry account for only 20% of expected energy savings by 2020. In addition, the energy savings expected to result from behavioural change-type measures is dwarfed by savings expected from other measures, both across households and industry.

The higher levels of R&D expenditure and other policy measures designed to raise energy efficiency are welcome; however, a review of the evidence on behavioural change suggests that the most successful energy efficiency strategies will combine both technological improvements with behavioural change amongst energy users and employees. Cebr and nBS therefore advocate that the new Department for Business, Energy and Industrial Strategy (BEIS) should continue to encourage businesses to increase energy efficiency, and seek to promote greater behavioural change amongst large businesses in particular. This is supported by a review of the evidence and literature surrounding behavioural change, which suggests that there are potentially large savings that could be achieved by businesses. These benefits would not be limited solely to the bottom line for businesses; other benefits are likely to include higher staff engagement and morale, improvement in corporate reputation and competitiveness, and greater protection against future energy price volatility.

By combining evidence from a variety of reputable sources, we estimate that UK business could achieve hundreds of millions of pounds of potential savings from the successful implementation of behavioural change. Potential savings are dependent on the degree to which businesses have already fostered behavioural change amongst their employees, and the measures taken to so. However, our central estimate of £600 million in potential business savings lies within the confines of existing evidence. Notably, between 40% and 50% of these potential savings could be achieved by large businesses in the UK, despite large businesses making up less than one percent of the business population.

Based on the evidence gathered and the results of our analysis, Cebr and npower Business Solutions (nBS) believe that there is a major opportunity for the new Department of Business, Energy and Industrial Strategy (BEIS) to encourage behavioural change to achieve savings across businesses – and particularly for large businesses.

between 40% and 50% of potential savings could be achieved by large businesses in the UK

Annex A: Potential business savings methodology

In this annex we explain in further detail the methodologies we have applied to estimate the potential savings that could result from behavioural change amongst businesses.

Defining businesses by size

The first step involves defining business categories by size, which is typically measured by the number of recorded employees. It should be stated that using the number of employees is one of several ways in which business size can be measured (alongside turnover, capital investment, market share or capitalisation); it is not always exact but in this context has enabled us to provide a UK-level extrapolation of the savings that could result from widespread behavioural change amongst businesses.

Businesses are categorised as being either "Micro", "Small", "Medium" or "Large". Whilst these categories are broad, they have enabled us to reflect the fact that in 2015 over 95% of businesses across all industries were Micro businesses, recorded as having fewer than 10 employees. In contrast, only 0.06% businesses had 500 employees or more.[39]

Business categories are shown in Table A.1 below:

Some registered and unregistered businesses are recorded as having no employees, but still have employment numbers associated with them within the business population. These businesses have been included in our study; to discard these would entail losing a large number of businesses from the analysis for which greater energy efficiency could also be beneficial.

Table A.1: Business categories by size

Category of business	Number of employees
Micro	0 - 9
Small	10 - 49
Medium	50 - 249
Large	250 or more

Source: ONS, BEIS

Approach I: Combining the Empower Calculator and the Business Population Estimates

The first approach we have used combines information from the Carbon Trust Empower calculator with the Business Population Estimates. The Empower calculator enables the estimation of potential business savings based on the inputted number of employees or the annual energy bill. We have used the former in combination with employment recorded in the Business Population Estimates to estimate savings.

The Carbon Trust Empower calculator incorporates 19 potential energy-saving measures, which are listed below in Table A.2 below. Not all of these measures relate to behavioural change, either relating instead to technological improvements or otherwise; we have therefore only retained those measures which involve campaigns, employees taking action and/or adapting behaviour.

Table A.2: Carbon Trust business energy efficiency measures

Measure	Description	Behavioural change measure?
Travelling to meetings	Set up tele or video-conferencing system and introduce a policy to use these instead of driving to meetings;	No
Computers and monitors	Enable computer energy-saving settings; set up a switch-off campaign to switch off monitors when away from their desks, and their computers at the end of the day;	Yes
Electric fan heaters	Switch off electric fan heaters and encourage staff to wear warmer clothes;	Yes
Paper recycling	Put up messaging to encourage employees to print double-sided or even two pages per slide, and reuse paper where possible;	No
Kettles	Put up signage to encourage employees to only fill the kettle as much as they need for one drink;	Yes
Office temperature	Reduce the temperature in your office to 21 degrees.	Yes
General recycling	Run a recycling campaign and put up signage to educate employees on what, and how to recycle different materials;	No
Hand dryers	Consider installing a modern high-speed hand-dryer in place of paper towels or old style dryers;	No
Lifts	Encourage your employees to be healthier and take the stairs instead of the lift;	Yes
Desk lamps and electric fans	Set up a switch-off campaign and remind employees to switch off electric fans or desk lamps when away from their desks and at the end of the day;	Yes
Water coolers	Purchase a timer to automatically switch off the water cooler at the end of the day;	No
Office equipment	Set up a switch-off campaign and remind employees to switch off printers, faxes, and photocopiers at the end of the day;	Yes
Dishwasher	Set dishwashers to economy setting and put signage to remind employees that it's more efficient to run the dishwasher when fully-loaded;	No
Mobile phone charger	Set up a switch-off campaign and remind your employees to unplug their phone chargers when they're not in use;	Yes
Leaking taps and showers	Set up a water-saving campaign to remind your employees to make sure they report leaky taps or showers;	No
Fridges	Ensure fridges are set to 4 degrees Celsius, aren't overstocked, and door seals are clean and secure;	No
Audio visual equipment	Set up a switch-off campaign and remind employees not to leave audio-visual equipment switched on or on standby when not in use;	Yes
Natural lighting	Switch off some or all of the artificial lighting in areas of the office that are sufficiently lit by natural daylight;	Yes
Office lighting	Set up a switch off campaign to remind employees to switch off the lights in a room that is empty, and at the end of day.	Yes

Source: Carbon Trust

There are notable differences in the degree of savings that could be achieved through the different behavioural change measures identified in Table A.2 above. In Table A.3 below we rank behavioural change measures by potential savings, using the example of a business with 100 employees:

Table A.1: Business categories by size

Behavioural change measure	Savings
Audio visual equipment	£1
Mobile phone chargers	£5
Office equipment	£54
Desk lamps and electric fans	£74
Lifts	£78
Kettles	£275
Natural lighting	£330
Office temperature	£413
Computers and monitors	£1,293
Office lighting	£1,716

Source: Carbon Trust

Not all of the behavioural change measures listed in Table A.2 above may be feasible across all businesses. For example, a micro business is unlikely to encourage staff to use the stairs instead of a lift within an office building; this measure is only likely to be achievable by medium or large businesses. At the same time, it is reasonable to assume that all businesses should be capable of encouraging staff to efficiently use office equipment.

Table A.4 below sets out which measures are assumed to be feasible by business category:

Table A.4: Behavioural change measures assumed to be feasible by business size

Behavioural change measure	Micro	Small	Medium	Large
Computers and monitors	Yes	Yes	Yes	Yes
Kettles	Yes	Yes	Yes	Yes
Mobile phone chargers	Yes	Yes	Yes	Yes
Office equipment	Yes	Yes	Yes	Yes
Audio visual equipment	No	Yes	Yes	Yes
Desk lamps and electric fans	No	Yes	Yes	Yes
Office temperature	No	Yes	Yes	Yes
Lifts	No	No	Yes	Yes
Natural lighting	No	No	Yes	Yes
Office lighting	No	No	Yes	Yes

Source: Cebr analysis

Finally, we have made assumptions to reflect the inherent uncertainty associated with the impact of behavioural change, we have attempted to accommodate this by basing our analysis on three different scenarios: "cautious", "moderate" and "optimistic". These scenarios assume varying levels of success in implementing behavioural change, ranging from relatively straightforward measures (such as efficient use of kettles and computers). The "optimistic" scenario assumes that all of the behavioural change measures listed in Table A.2 are successfully introduced across all of the UK businesses in which these measures can be feasibly implemented. Introducing these scenarios into our analysis is useful for two reasons: firstly, they reflect the strong likelihood that many UK businesses will have already attempted to introduce or encourage some forms of behavioural change amongst their employees. Secondly, they provide a "sense check" in terms of feasible change that could be realistically achieved given variations in energy usage across sectors. The three scenarios are listed in Table A.5 below:

Table A.5: Different scenarios based and the behavioural change measures assumed to be introduced

Behavioural change measure	Cautious	Moderate	Optimistic
Mobile phone chargers	Yes	Yes	Yes
Kettles	Yes	Yes	Yes
Computers and monitors	Yes	Yes	Yes
Electric fan heaters	Yes	Yes	Yes
Office temperature	No	Yes	Yes
Audio visual equipment	No	Yes	Yes
Office equipment	No	Yes	Yes
Natural lighting	No	Yes	Yes
Desk lamps and electric fans	No	No	Yes
Office lighting	No	No	Yes

Source: Cebr analysis

Approach II:
Combining DECC pricing and consumption data with the Business Population Estimates

Here we detail the methodology behind our second approach, which acts as a "sense-check" to the first approach above by drawing upon electricity and gas consumption and pricing data previously published by DECC, as well as alternative assumptions for the potential savings from behavioural change.

For the second approach, we have utilised existing DECC estimates for electricity and gas costs per size of business as determined by energy usage. These statistics are released as part of the DECC's former statistical pricing series prior to the Department's abolition.[40] The prices per unit of electricity and gas (measured by pounds per KWh), both of which are disaggregated by the different business categories shown in Table A.1 above.

The approximate price of electricity and gas by business size is then shown in Table A.6 below:

Table A.6: Industrial energy prices, £ per Kilowatt hour (KWh)

Business size	Electricity price per KWh	Gas price per KWh
Micro	£0.13	£0.04
Small	£0.12	£0.03
Medium	£0.10	£0.03
Large	£0.10	£0.02

Source: DECC, Cebr analysis

We have also drawn upon energy use statistics in the former DECC's Non-domestic National Energy Efficiency Data-Framework (NEED).[41] NEED provides a breakdown of electricity usage by Micro, Small, Medium and Large Businesses, using data from electricity and gas meters in non-domestic sites in England and Wales. This has then provided an indication of the proportions of electricity usage by different business categories.

Tables A.7 and A.8 below show the breakdown of electricity and gas consumption across businesses of different sizes from 2006 to 2012. We have used the latest data for 2012 to estimate the share of total electricity and gas consumption in 2015 across the different business categories.

Table A.7: Implied electricity consumption by size of business

Category of business (number of employees)	2006	2007	2008	2009	2010	2011	2012
Micro (<10)	20.7%	21.1%	19.8%	21.2%	21.2%	21.5%	20.7%
Small (11-49)	16.3%	16.7%	15.4%	16.5%	16.5%	17.7%	17.1%
Medium (50 -249)	18.5%	17.8%	18.7%	18.8%	20.0%	19.0%	19.5%
Large	16.3%	16.7%	16.5%	15.3%	16.5%	15.2%	15.9%
Very Large (1000+)	28.3%	27.8%	27.5%	27.1%	25.9%	26.6%	26.8%

Source: DECC. Note: figures are subject to rounding

Table A.8: Implied gas consumption by size of business

Category of business (number of employees)	2006	2007	2008	2009	2010	2011	2012
Micro (<10)	17.9%	17.2%	17.6%	17.0%	16.4%	16.4%	16.4%
Small (11-49)	11.4%	10.7%	10.9%	10.7%	10.3%	10.9%	11.8%
Medium (50 -249)	20.3%	22.1%	21.0%	20.5%	20.7%	21.8%	21.8%
Large	19.5%	19.7%	16.8%	16.1%	16.4%	16.4%	15.5%
Very Large (1000+)	31.7%	31.1%	34.5%	34.8%	36.2%	34.5%	33.6%

Source: DECC. Note: figures are subject to rounding

Finally, we have applied different assumptions for the potential savings that businesses of different size could achieve through behavioural change. As with the first approach, we have produced three different scenarios which reflect different levels of savings. These assumptions are informed by the existing estimates of potential business savings sourced from nBS, DECC and the academic literature discussed earlier in this report. Potential savings are set to be higher for larger businesses in the Moderate and Optimistic scenarios to reflect their greater scope to foster behavioural change.

Table A.9 below sets out the savings assumptions applied:

Table A.9: Behavioural change saving scenarios

Potential energy savings by category of business	Cautious	Moderate	Optimistic
Micro	2%	3%	6%
Small	2%	3%	6%
Medium	3%	6%	9%
Large	6%	9%	10%

Source: Cebr analysis

References

1 In July 2016 DECC merged with the Department of Business, Innovation and Skills (BIS) to form the new Department of Business, Energy and Industrial Strategy (BEIS). The new department brings together responsibilities for business, industrial strategy, science, innovation, energy, and climate change. This report references insight and analysis produced by DECC and BIS prior to their merger.

2 DECC Energy Efficiency Strategy, 2013 Update

3 IEA, http://www.iea.org/topics/energyefficiency/

4 Whilst related, energy efficiency should not be confused with energy intensity; the latter is a broader concept which represents the quantity of energy required to produce each additional unit of Gross Domestic Product (GDP) or Gross Value Added (GVA)

5 IEA (2012). Energy Policies of IEA countries: The United Kingdom 2012 review

6 GVA is also commonly known as income from production and is distributed in three directions – to employees, to shareholders and to government. GVA tends to be used for measuring things like regional gross domestic product and other measures of economic output of entities that are smaller than the whole economy – therefore it is appropriate for use here to measure the economic contribution of industry.

7 BEIS (2016). Energy Consumption in the UK

8 ADEME (2015)."Energy Efficiency Trends and Policies in Industry: An Analysis Based on the ODYSSEE and MURE databases"

9 European Energy Agency (2016). Progress on Energy Efficiency in Europe

10 Ibid.

11 Dolan, P, and Metcalfe, R. (2015) "Neighbors, knowledge, and nuggets: two natural field experiments on the role of incentives on energy conservation." Becker Friedman Institute for Research in Economics Working Paper 2589269.

12 Abrahamse, W., & Steg, L. (2011). Factors Related to Household Energy Use and Intention to Reduce It: The Role of Psychological and Socio-Demographic Variables. Human Ecology Review, 18(1), pp.30-40.

13 ADEME (2015). "Energy Efficiency Trends and Policies in the Household and Tertiary Sectors: An Analysis Based on the ODYSSEE and MURE databases"

14 ODEX is an index weighting the energy efficiency progress by end-use/appliance measured from changes in specific consumption measured in different units, including heating, water heating, cooking, refrigerators, freezers, washing machines, dishwashers and TVs.

15 IEA Data Services (2016). http://data.iea.org/

16 Countries included in the IEA R&D expenditure dataset are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, South Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the UK and the US.

17 ADEME, ODYYSEE MURE project (2016). http://www.odyssee-mure.eu/

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33 Parliamentary Office of Science and Technology (2012). "Energy Use Behavioural Change"

34 DECC (2015). SME Energy Efficiency Guide

35 Daily Telegraph (28th March 2016). "Business could save £1bn through energy behaviour change"

36 The Carbon Trust. Empower savings calculator, https://www.carbontrust.com/resources/tools/empower-savings-calculator

37 ONS Supply Use tables, intermediate consumption 2013.

38 Ibid.

39 BIS (now BEIS), Business Population Estimates 2015

40 DECC (2016). Gas and electricity prices in the non-domestic sector, Industrial Energy Price Statistics

41 DECC, https://www.gov.uk/government/statistics/the-non-domestic-national-energy-efficiency-data-framework-nd-need

Notes