Department of Energy & Climate Change

The Energy Efficiency Strategy:

The Energy Efficiency Opportunity in the UK

Strategy and Annexes

November 2012

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The Mission

- Improving our energy efficiency is a key strategic objective for the Coalition Government. It is fundamental to decarbonising the UK, maintaining secure energy supplies, and increasing the productivity of our businesses. We have a proud history of making the very most of our resources and energy should be no different.
- **This Coalition Government has a mission to seize the energy efficiency opportunity, accelerating the deployment of twenty-first century energy saving measures through:**
  - **connecting energy efficiency knowledge and technologies to finance seeking strong returns;**
  - **supporting energy efficiency innovation;**
  - **harnessing the power of improved energy use information, driving its availability and disclosure; and**
  - **encouraging collective action to act on this new and better information.**
- As set out in this strategy the benefits to energy efficiency can be significant, including:
  - boosting growth and creating jobs in our economy;
  - saving households and businesses money on fuel bills;
  - creating a more sustainable and secure energy system;
  - delivering cost effectively against our climate change goals; and
  - reducing energy imports.
- The December 2011 Carbon Plan was clear that, if we are to cut our green house gas emissions by 80% by 2050, 'energy efficiency will have to increase dramatically across all sectors'. It set out four possible scenarios for 2050, relative to 1990, which imply a per capita demand reduction of between 31% and 54% relative to 2007.
- This Government has already made progress through radical initiatives such as the Green Deal, but this Strategy pinpoints the remaining energy efficiency potential within the UK economy and summarises the actions we will now take to realise this.

Contents

Ministerial Foreword

Energy efficiency belongs at the heart of a low-carbon economy. By reducing energy use and cutting down on waste, we can reduce energy bills, make our energy system more sustainable, and drive down greenhouse gas emissions.

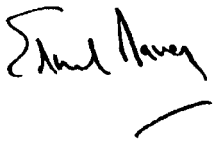
Too often, governments have neglected the role that energy demand reduction can play in managing our energy system. Yet measures that reduce demand can contribute in a more cost-effective way to meeting our energy and climate goals than supply-side measures. That's why energy efficiency – as a way of reducing demand – takes pride of place at the centre of the Coalition Government's policy framework.

I want Britain to get as close as possible to using only the energy we really need. We could be saving 196TWh in 2020, equivalent to 22 power stations through, socially cost-effective investment in energy efficiency. That is around 11% lower than the business as usual baseline. It could also reduce carbon emissions by 41 $MtCO_2e$, contributing to achieving our carbon budgets.

Britain's homes have been built and developed over hundreds of years, and their energy efficiency varies from good to dreadful. Bringing as many homes as possible up to the level of the best is not only a worthwhile investment; it also presents a huge business opportunity, including a chance for British companies to develop expertise which can be exported to overseas markets.

This strategy sets the direction for energy efficiency policy for the coming decades. It makes clear our ambition, the barriers that we need to address, and the additional steps we are taking now to stimulate the energy efficiency market. It shows how we will act to connect finance with demand, encourage innovation, and make energy efficiency information more accessible to the consumer.

Energy efficiency can reduce energy bills for households and businesses, and can boost the economy in a sector with great potential for future growth, driving innovation in the process. The prospect of achieving more with less energy is an exciting one, and this strategy sets out the opportunity in full.



Edward Davey
Secretary of State for Energy and Climate Change

Clarification of scope

The Energy Efficiency Deployment Office (EEDO)

EEDO has developed this Strategy, drawing from expertise across Government and considering energy efficiency potential across the UK economy, including in businesses, buildings, products and transport. It is the first in a series of documents that EEDO will produce.

EEDO has been set up within DECC to support the delivery of our existing energy efficiency policies, by improving our evidence base and analysis, ensuring effective delivery against the observed energy efficiency potential in the economy, and by bringing coherence to the Government's offer to the consumer.

Beyond DECC, EEDO forms an inclusive initiative with UK Government Departments, the Scottish and Welsh Governments represented on its quarterly Steering Board and Northern Ireland having observer status. As the evidence base is developed, the objective will be to share information, by region and sectors where possible, and consider solutions to achieving further energy efficiency potential as a group.

Devolution

Any development of policy in the area of energy efficiency needs to take into account the following arrangements:

- that, in Scotland[1] and Wales, the encouragement of energy efficiency is devolved, while the regulation of energy efficiency is reserved; and
- that the promotion and regulation of energy efficiency is devolved to Northern Ireland.

Furthermore, as policy ideas in this Strategy are developed they will need to take account of where they may impact on other policy areas that are devolved to Scotland and Wales. Northern Ireland are able to draw from EEDO's work as it considers its own future energy efficiency policy.

This approach is reflected in this Strategy, with differences between the policy frameworks of devolved Governments clearly referenced.

1 *Low Carbon Scotland*, the Scottish Government's first report on proposals for meeting the annual climate change targets set under the Climate Change (Scotland) Act 2009. http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/lowcarbon/rpp

The Energy Efficiency Opportunity in the UK

1. The UK now has a huge opportunity to optimise the energy use of both domestic and business customers, reducing bills and/or warming homes, while at the same time, delivering a more sustainable society. Individuals can do this through taking action to reduce their demand, such as turning off energy using products that are not in use, buying products that are more efficient or installing energy efficiency measures in their homes. Businesses can take similar actions, reducing their long term operating costs. The critical importance of energy efficiency to our long-term energy policy is reflected in last December's **Carbon Plan**[2].

2. Many of the views received in response to the February 2012 Energy Efficiency Call for Evidence[3,4] recognised huge potential but asked for greater certainty on what was needed to improve our energy efficiency at a national level. This response sets out the long term direction required as well as specific actions that will be taken now.

"This is an Energy Efficiency Strategy to maximise existing policy and realise the wider energy efficiency potential that is available in the UK economy."

3. This strategy identifies four overarching barriers to greater energy efficiency that have to be overcome. Action is already being taken, but if we further pursue these barriers we will be able develop a stronger, self sustaining energy efficiency market and more consumers will be able to see a return, creating positive reinforcement of the potential of energy efficiency. The four corresponding 'barrier annexes' to this strategy[5] outline those policies that are already in place to tackle these issues and provide case studies where public and private sector organisations have already been successful in achieving greater energy efficiency, realising the associated benefits.

4. Our broad assessment of the policy framework is that the energy efficiency agenda for households is well covered by existing initiatives, although there is still a need to maximise the way these policies work. There is, however, particular further interest in significant commercial and industrial energy efficiency potential not already covered by the existing policy.

"We estimate that through socially cost-effective investment in energy efficiency we could be saving 196TWh in 2020, equivalent to 22 power stations[6,7]".

2 Carbon Plan, DECC, December 2011
3 Energy Efficiency Call for Evidence, DECC, 8 February 2012.
4 The Government's Call for Evidence summary of responses can be found at Annex F of this strategy.
5 Annexes A-D.
6 The costs and benefits of measures have been calculated from the societal perspective, in line with the appraisal guidance set out in the Green Book and the supplementary guidance provided by the Inter-departmental Analysts' Group on valuing carbon emissions avoided, energy savings and air quality improvements. This means that the value of energy savings is based on the resource costs, not the retail price (and non-traded carbon emissions and air quality impacts are included). Capital costs are assumed to be paid upfront and financing costs are excluded. The costs and benefits are discounted over time at the social discount rate. A measure that is cost-effective from the societal perspective may not be cost effective for the individual investor. For more detail on the methodology of the EE-MACC, see Annex E.
7 Assumption of a power station with 1 GW capacity operating full-time..

5. The potential for the 2020s is even greater. Considered in this way, energy efficiency can play a major role in the UK's balancing of energy demand and supply.

6. Box 1 provides a summary of additional actions we are taking alongside this strategy in order to help stimulate a self sustaining energy efficiency market. These actions and others across the broad energy efficiency spectrum are covered in more detail within the barrier annexes.

Understanding energy efficiency

"Energy efficiency is a measure of energy used for delivering a given service. Improving energy efficiency means getting more from the energy that we use."

7. There are different ways to improve energy efficiency. For example:

- **'Innovation'** can lead to the equal or greater output with less energy.
- **'Cutting out wasted energy'** reduces energy needed while maintaining output.

Box 1: Further action taken as part of this Energy Efficiency Strategy

- A key focus is **supporting the finance market** through: publishing guidance on financing energy efficiency for the public sector; announcing a research project with ENWORKS to understand the process, costs and benefits of financed energy efficiency projects; initiating an assessment of compatibility of energy efficiency investments with the public sector budgeting framework; taking the RE:FIT programme, which facilitates the public sector use of the ESCO market, nation-wide and the Electricity Demand Reduction project.
- We are going further on **energy efficiency innovation** by: announcing three new 'energy efficiency' Technology Innovation Needs Assessments (TINAs); sponsoring three new energy efficiency Green Business Awards; and, reviewing the way that new innovative energy efficiency measures are reviewed and accredited.
- We are working to **strengthen the evidence base** through: commissioning research into the potential of advanced heating controls; working with the IEA to explore all benefits of energy efficiency; setting out a future DECC Evidence Strategy; and co-ordinating with Research Councils UK and others, to support the development of a knowledge hub for the refurbishment of existing homes as well new Energy Demand Research Centres, announced with this strategy.
- A further focus area is **controls and information**, where we will: launch a behavioural trial with the John Lewis Partnership on whether providing information on lifetime electricity running costs helps consumers; making funding available to increase the proportion of facilities managers receiving specialist energy efficiency training; develop a trial to study the impact of advice on how to use heating controls provided when boiler checks are carried out; and announce a forthcoming DECC Community Energy Strategy as well as commission a Community Energy Efficiency Outreach Programme with Groundwork UK.
- Within **audits and standards**, we will focus on: beginning the process for implementing energy audits for non-SME enterprises, as required by the Energy Efficiency Directive; and seeking the ISO50001 Energy Management Standard accreditation for DECC.

- **'Heating technologies'**, such as heat pumps, can deliver greater output for less supplier energy.

8. Through greater energy efficiency we can use less primary fuel or power to enjoy the same level of output. For example, by improving manufacturing equipment it is possible to produce the same or more with lower overheads. Improved energy efficiency can provide many economic, social and environmental benefits for the UK and yet we are not doing all we can to realise them.

9. Clearly, this is not a new policy agenda. The first energy demand reduction policies were developed by the Department of Energy in 1974 in response to oil shocks and many different approaches have been taken since to improve our energy use efficiency, with some success[8]. Approaches have changed, as have the ways in which we have used energy, but there has never been a quick fix. So why an Energy Efficiency Strategy now?

10. We must continue to find solutions, such as those provided by the Green Deal and Smart Meters, which allow us to tap into the cost effective energy efficiency improvements that are right there in front of us; whether it be through more efficient industrial processes, better use of heat, or simply installing energy efficient lighting.

The energy efficiency opportunity

11. The energy efficiency sector in the UK already accounts for about 136,000 jobs and had sales of £17.6 billion in 2010/11. Sales in this sector have grown by over 4% per year in the UK since 2007/08, and are projected to grow by around 5% per year between 2010/11 and 2014/15. However, there is more potential in the market[9].

12. Stephen Chu, the US Secretary of Energy, has said that "energy efficiency is not just low-hanging fruit; it is fruit that is lying on the ground"[10]. With the right market in the UK we could unlock more of the potential for energy efficiency investment, helping to generate growth and jobs. Alongside the associated carbon reductions, improvements in our energy security by reducing demand for imported

Box 2: Why now?

There are good reasons to set the direction on improving energy efficiency in the UK:

- **finding ways to do more (or the same) with less** makes economic sense;
- **it can help households and businesses reduce their energy bills** at a time of increasing energy prices;
- many **energy efficiency improvement schemes are approaching implementation** and we need to clearly set out the linkages and the collective ambition;
- we need to be clear as to **the role of demand side management** as our electricity generation market is reformed; and
- energy efficiency needs to be taken forward as a cost effective solution to carbon reduction to meet **our carbon budgets**.

8 See Figure 3 for the trend of consumption per capita in the UK.

9 K-Matrix, Low Carbon and Environmental Goods and Services data (2010-11). The energy efficiency sector has been defined as the energy management and building technologies subsectors. http://www.bis.gov.uk/policies/business-sectors/green-economy/market-intelligence/market-data

10 Steven Chu, The Times, London, 26 May 2012..

energy, warmer homes and lower resulting energy bills mean increasing energy efficiency is win-win-win. We must, and will, make it happen in the UK. Greater energy efficiency may also support improvements in wider resource efficiency.

Energy efficiency potential in the UK economy

13. Responses to the Energy Efficiency Call for Evidence highlighted the significant energy efficiency potential in the UK economy and detailed analysis confirms that there is significant cost effective potential. The Energy Efficiency Marginal Abatement Cost Curve (EE-MACC) estimates the energy savings through implementing energy efficiency measures. It is based on detailed modelling of ambitious scenarios for the potential for investment in energy efficiency from different sectors of the economy, based on current evidence. The more cost-effective a measure, the closer it is to the left-hand side of the chart. For more detail on the methodology and assumptions see Annex E.

14. We estimate that through socially cost-effective investment in energy efficiency we could be saving 196TWh in 2020, equivalent to 22 power stations[11,12]. Were all this potential to be realised, final energy consumption in 2020 could be 11% lower than the business as usual baseline. This potential can be found across the UK economy and realising this could have significant benefits for businesses and households. For example, the EE-MACC analysis suggests there is potential for cost effective energy efficiency in commercial buildings and industry over and above that which we expect to be realised through policies such as the EU-ETS, CCAs or CRC (DECC analysis suggests that around 14% of total energy use in the business and public sector are in organisations that are not included in these policies).

15. Further, there is the potential to save energy through changing how we use it, both in domestic and business settings, while maintaining the benefits delivered. This potential is not fully captured within the framework of the EE-MACC. Developing a stronger understanding of the potential for energy efficiency and evaluating the impact of policy on incentives to invest in energy efficiency is a priority for EEDO. As the evidence base improves, the detailed assessment what the potential is for energy efficiency investment may be adjusted.

The benefits of energy efficiency

16. **Economic growth:** Installing energy efficiency measures often requires local labour[13], and the investment has the potential to boost employment and economic growth. The business community see this as important in the current global economic climate[14,15]. There are also long-term growth benefits. For example, lower domestic energy bills can lead to higher disposable incomes that can be spent elsewhere in the economy, while businesses can see a reduction in running costs and so an increase in productivity. Simple changes in energy use

11 The costs and benefits of measures have been calculated from the societal perspective, in line with the appraisal guidance set out in the Green Book and the supplementary guidance provided by the Inter-departmental Analysts' Group on valuing carbon emissions avoided, energy savings and air quality improvements .This means that the value of energy savings is based on the resource costs, not the retail price (and non-traded carbon emissions and air quality impacts are included). The capital costs are assumed to be paid up front and financing costs are not included. The costs and benefits are discounted over time at the social discount rate. A measure that is cost-effective from the societal perspective may not be cost effective for the individual investor (and vice versa).

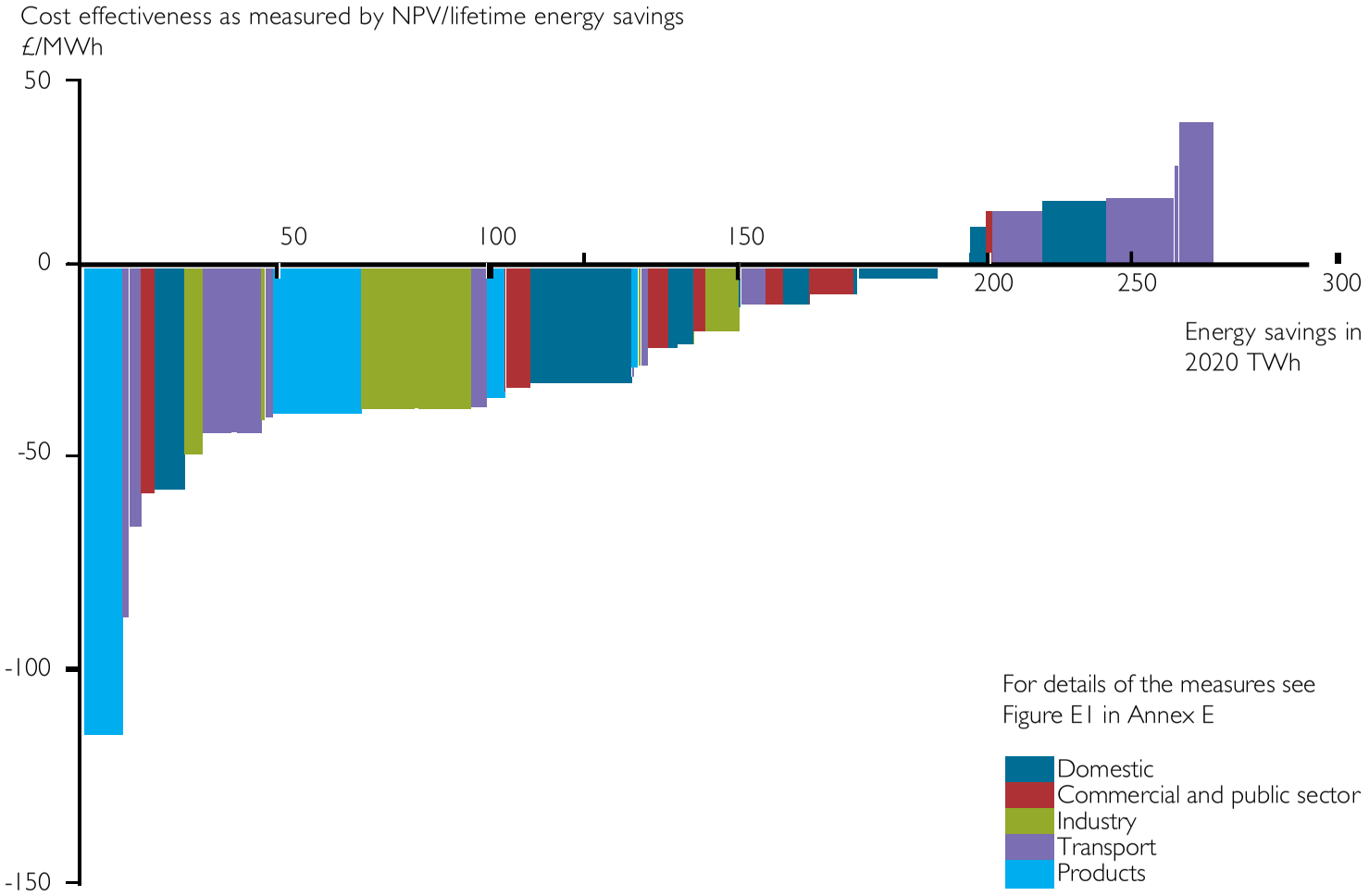
12 Asssumption of a power station with 1 GW capacity operating full-time.

13 Last year Groundwork, a third sector organisation, helped 4,200 people progress into training, education or employment, many of them into 'green jobs' (see Annex D for more detail).

14 Economist Intelligence Unit, Energy Efficiency and energy savings: a view from the buildings sector, October 2012, http://www.globalbuildings.org/resources/uploads/Report_EIU_GBPN.pdf

15 The colour of growth: Maximising the potential of green business, CBI, July 2012.

Figure 1: 2020 Energy Efficiency Marginal Abatement Cost Curve



Notes:

For more detail on the methodology and assumptions see Annex E consistent with the 2012 DECC energy projections and supplementary Green Book Guidance appraisal guidance. The business as usual baseline excludes policies that have been introduced since 2009. The net present values are calculated in 2012 terms.

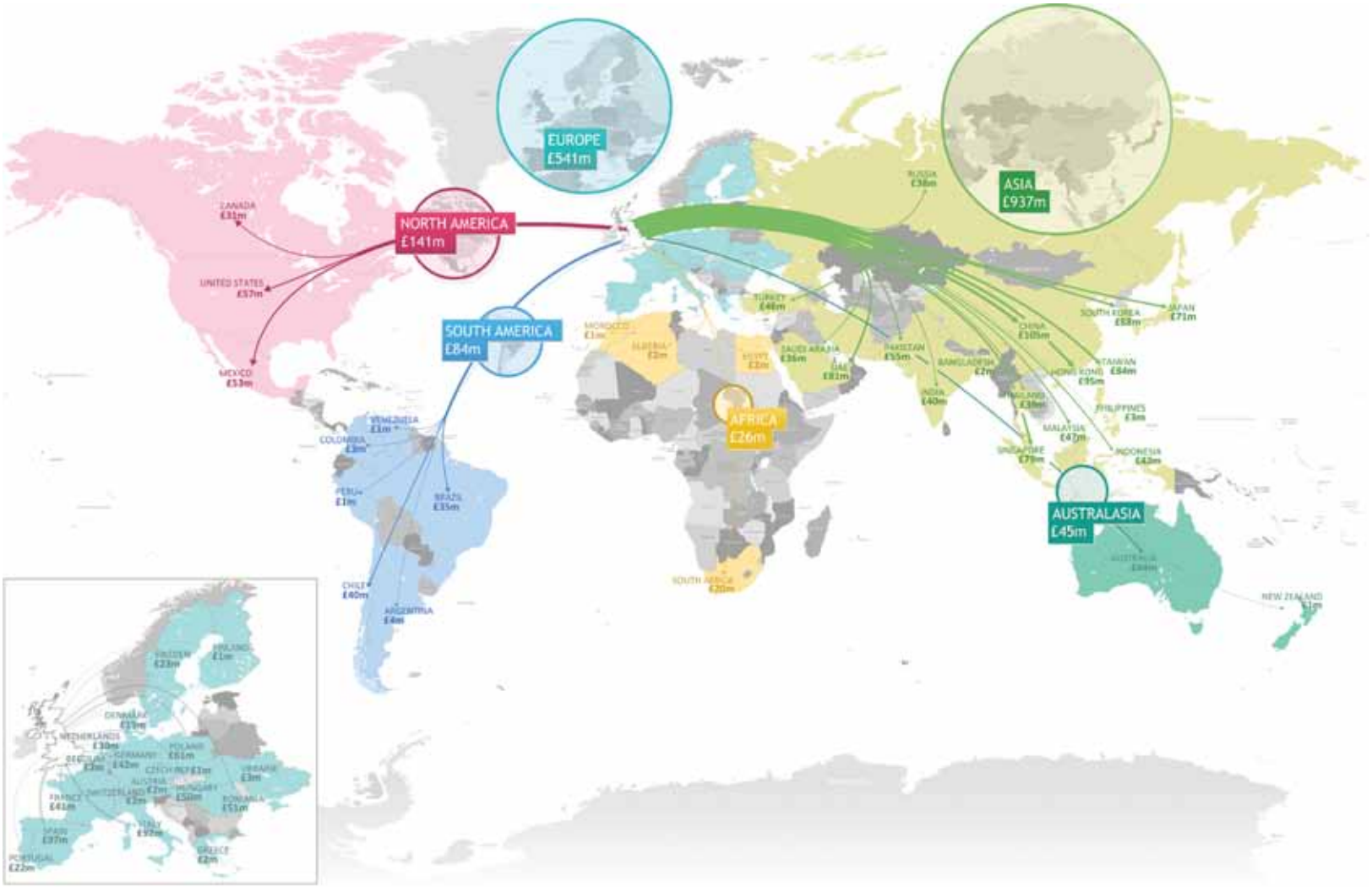
Products policy estimates become increasingly uncertain beyond 2020, where the market may naturally deliver more efficient products – this will be reviewed in future. The energy savings from Tranche 1 and 2 of products policy within the industrial sector have been included in the potential for energy savings in industry.

Smart meters estimates are consistent with cost and savings assumptions as applied in the smart meter impact assessment and costs required for the delivery of the policy are taken into account (i.e. not only the asset costs for the provision of the technology are reflected). To be consistent with the methodology used here, financing costs have been excluded.

The transport analysis is consistent with that included in the Carbon Plan (December 2011). The assumptions, on fuel prices and growth for example, have not been revised since.

Estimates for the energy savings from CERT (20% uplift and extension) and CESP are consistent with the projected net energy savings set out in the DECC energy projections. The estimates of energy savings is net of comfort taking, but we have not valued comfort taking for these measures. The NPV for these policies is estimated based on discounting to 2009.

Figure 2: UK energy efficiency exports in 2010/11[12]



Exports from the UK Energy Efficiency Sector in 2010/11 were worth £1.8 billion

16 K-Matrix, Low Carbon and Environmental Goods and Services data (2010-11). The figure shows the size of UK Energy Efficiency Sector exports in 2010/11 to 50 other countries. These are the countries with the highest sales from their own Low Carbon and Environmental Goods and Services sectors, based on when the data series started in 2007/08.

behaviour can deliver some of these benefits with little up-front cost.

17. Longer term investment in energy efficiency technology can also lead to a virtuous circle as innovation leads to cost reductions which can make it cheaper and easier to invest in energy efficiency in the future. Developing our innovative capacity in technology, materials or business models for energy efficiency opens up the potential for increasingly significant export opportunities for the UK as the global effort to combat climate change ramps up.

18. Thinking more broadly than headline export figures, we can see real examples of UK expertise shaping people's approach to energy efficiency across the globe. For instance:

- Mark Group using the know-how developed over four decades in the UK to establish successful energy saving operations in the USA, Australia and New Zealand.
- CO_2 balance supporting the distribution of energy efficient stoves in Tanzania.
- Arup carrying out energy efficiency audit work on university campuses in the USA.
- The BRE (Building Research Establishment) are working with partners in China and Brazil to develop Green Building Demonstration Parks where UK companies can showcase their world-class building techniques, products and services for homes and communities and help set the standard for sustainable development.

19. Economic studies show that improved energy efficiency can bolster productivity, increasing growth and reducing inflation. A study of the Government's energy efficiency policy between 2000-2007 estimated that these policies increased the annual rate of economic growth by around 0.1 percentage points within that period[17]. The study also estimated that these policies resulted in roughly 270,000 additional jobs in 2010 owing to the cumulative impact of higher growth. Looking forward, DECC analysis suggests that the

Box 3: Energy efficiency and the DECC fuel poverty strategy for England

Tackling fuel poverty is about helping people on low incomes who cannot keep warm at reasonable cost. There is some evidence that certain vulnerable groups, such as households with older people and children, can be the most at risk of health detriments associated with cold homes, such as respiratory illnesses. Energy efficiency has a clear role to play in assisting these households, insulating them from the cold as well as the effects of rising energy prices.

Earlier this year, Professor John Hills published his review of fuel poverty. In it he proposed a new framework for measuring fuel poverty, which the Government has announced it intends to adopt subject to the outcome of an ongoing consultation. The Government also announced it would publish a new fuel poverty strategy in 2013.

Under the proposed new measurement approach, a household is fuel poor if it is low income and has high energy costs relative to all other households. A key factor driving energy costs is, of course, energy efficiency. As such, the Government's new strategy will set out how energy efficiency improvements can be made in such households, to provide a sustainable means of reducing costs.

17 Barker, T., Ekins, P., & Foxon, T. (2007). The macro-economic rebound effect and the UK economy. Energy Policy, 4935-4946..

Green Deal and ECO alone could support up to 60,000 jobs across the UK in 2015[18].

20. **Savings for domestic and business consumers:** As highlighted as part of the recent 'Big Energy Saving Week', improving the UK's energy efficiency is central to delivering a fair deal for the consumer. UK households are already benefitting from improvements in energy efficiency such as heating efficiency and insulation. Building Research Establishment modelling suggests that, if no energy efficiency gains had been made since 1970, current energy use would be almost double their current levels, adding about £1,000 to the average annual energy bill[19]. Energy efficiency will continue to have a role in driving long term reductions in household energy bills.

21. Wellbeing can also be enhanced through increased energy efficiency. For example, a higher disposable income, as a result of lower energy bills, can allow increased spending on other necessities. In addition, the health benefits from properly installed energy efficiency measures can be significant. It is possible to quantify health benefits in quality of life terms, in line with the principles of the Department of Health/NICE guidance. DECC modelling of the impact of the installation of solid wall insulation in all properties in England, gives a total improvement in the health of those individuals in the properties of £3.5bn – £5.0bn over the lifetime of the measures. If all cavity walls reported unfilled in 2009 were also filled this would provide a further monetised health benefit of £4bn – £6bn over lifetime of the insulation[20].

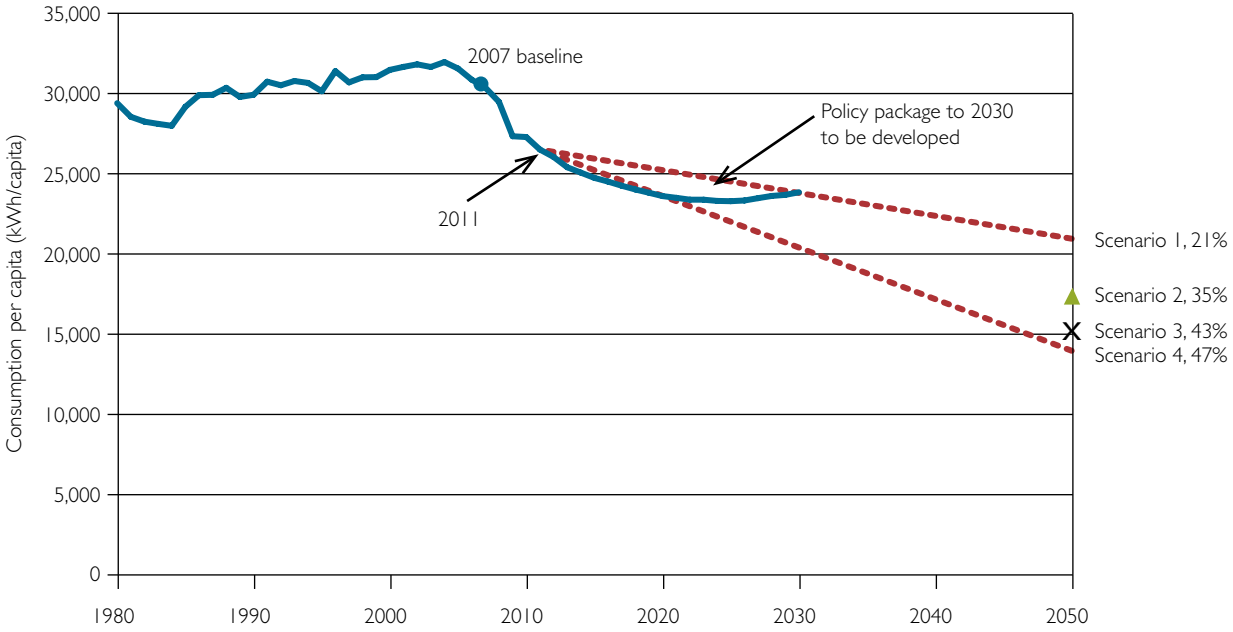
22. Some of the financial savings from energy efficiency measures may be spent on energy consuming goods and services: the rebound effect. This means that the overall impact on energy consumption is smaller, although consumers may feel a benefit from the additional energy consumption. The nature of rebound effect will vary depending on the energy efficiency measures adopted. For example if someone increases the level of insulation in their property, the direct rebound effect would be an increase in the temperature to which the house is heated and an indirect rebound effect would be using the savings on heating bills to buy an additional television. It is possible that the direct rebound effect might be reduced through providing advice when energy efficiency measures are installed.

23. Energy efficiency is also one of the central pillars of the Government's efforts to tackle fuel poverty. Improving the energy efficiency of the home is often the most cost-effective way of making a sustained reduction in household heating costs and removing that household from fuel poverty. Professor John Hills' Review of Fuel Poverty in England[21] included a consideration of the role of energy efficiency in helping vulnerable groups (see box 3).

24. **Emission reductions:** To deliver against our greenhouse gas emission targets over the coming decades in the most cost effective way, we need energy efficiency to improve significantly across all sectors. The 2011 Carbon Plan[22] sets out scenarios through which the UK could meet its legally binding target to reduce greenhouse gas emissions by 80% between 1990 and 2050. The Carbon Plan 2050 scenarios require energy efficiency to contribute a reduction in final energy consumption per capita between 2007 and 2050 of 31-54%. Figure 3 shows that, after moving to a 2011 baseline, these Carbon Plan Scenarios now require per capita savings of between 21% and

18 Final Impact Assessment for the Green Deal, DECC, June 2012
19 Energy savings from Energy Consumption in the UK table 3.18 and current energy prices.
20 Preliminary modelling that assumes the insulation measures are valued over their lifetimes and are appropriately installed in line with regulations and industry guidance.
21 Scotland, Wales and Northern Ireland have a separate fuel poverty strategy and fuel poverty programmes.
22 Carbon Plan, DECC, December 2011.

Figure 3: UK final energy consumption per capita compared against carbon plan scenarios: 1980-2050[23]



47% between 2011 and 2050. The current policy package is on track to be comfortably within this range through to 2020 but additional action is needed to maintain progress after 2020[24] and energy efficiency tends to be a cost-effective option.

Box 4: DECC 2050 Scenarios

In the 2011 Carbon Plan, DECC set out four scenarios to achieve reductions in greenhouse gases of 80 per cent between 1990 and 2050. These scenarios were set against a 2007 baseline.

- Scenario 1: Low energy efficiency and high nuclear generation (31% energy per capita saving from 2007 baseline).
- Scenario 2: High Carbon Capture & Storage (CCS) and additional Bio-energy (43% energy per capita saving from 2007 baseline).
- Scenario 3:CORE MARKAL scenario (50% energy per capita saving from 2007 baseline).
- Scenario 4: High energy efficiency and higher renewables (54% energy per capita saving from 2007 baseline).

***Note: Figures 3 and 4 these scenarios have been extrapolated to a 2011 baseline.**

23 Energy Efficiency Statistical Summary http://www.decc.gov.uk/eedo

24 *Low Carbon Scotland* (http://www.scotland.gov.uk/Topics/Environment/climatechange/scotlands-action/lowcarbon/rpp), the Scottish Government's first report on proposals for meeting the annual climate change targets set under the Climate Change (Scotland) Act 2009 details areas of joint working such as the establishment of the Green Deal and ECO and also highlights Scottish initiatives such as its approach to retrofitting insulation in existing homes and Scotland's targets for renewable heat and electricity.

Figure 4: UK final energy consumption compared against carbon plan scenarios: 1980-2050

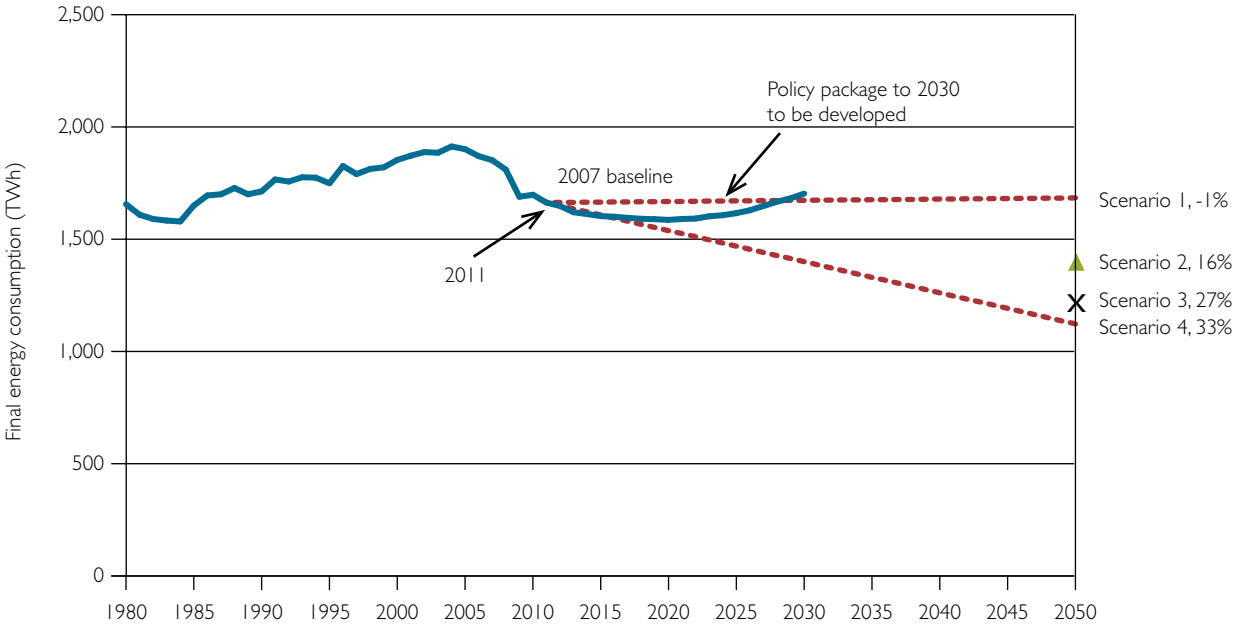
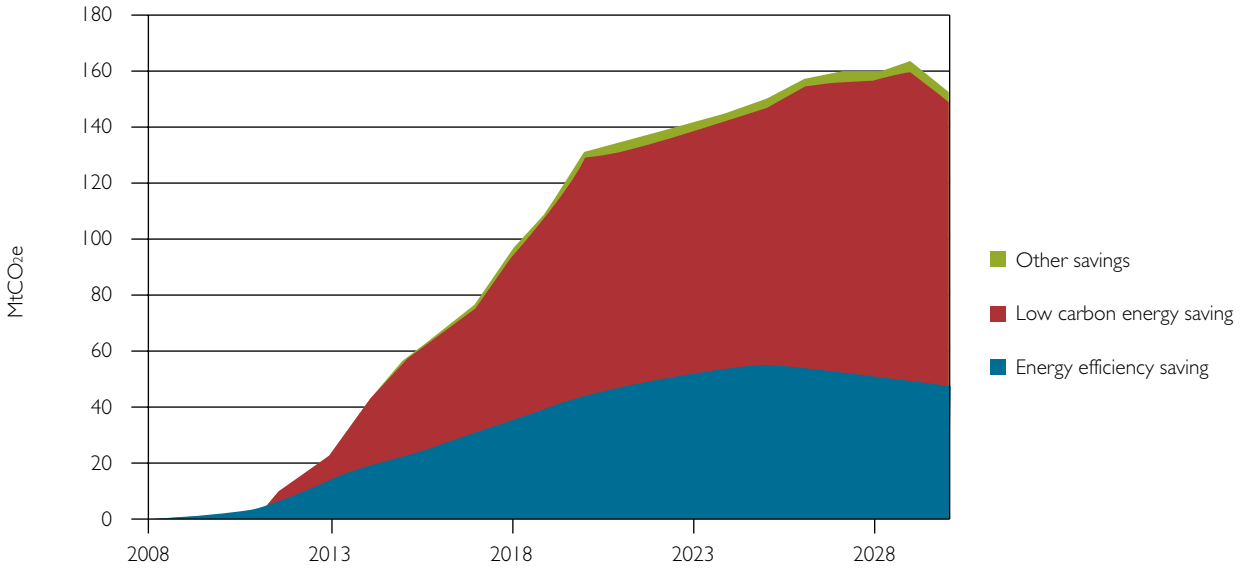


Figure 5: Projected savings of Green House Gas (GHG) emissions by type: 2010-2030[25,26,27]



25 Greenhouse gases include Carbon dioxide, Methane, Nitrous Oxide, Hydrofluorocarbons, Perfluorocarbons and Sulphur hexafluoride. These are presented as CO_2 equivalent based on their Global Warming Potentials. Non-CO_2 emissions arise from non-energy related activity for example methane from agriculture and fluorinated gases from industrial processes. Low carbon energy savings' includes generation and transport. 'Other savings' are the non-CO_2 savings from agriculture and waste. (Energy Efficiency Statistical Summary http://www.decc.gov.uk/eedo)

26 Energy efficiency policies have been defined as those aimed to reduce final energy consumption (for example product standards or installing insulation) Low carbon energy savings include switching to low carbon energy sources (e.g. renewable electricity, transport bio-fuels etc) and transformation sector energy savings. Other savings include savings of non-CO_2 greenhouse gases.

27 DECC, Updated Energy and Emissions Projections, October 2012.

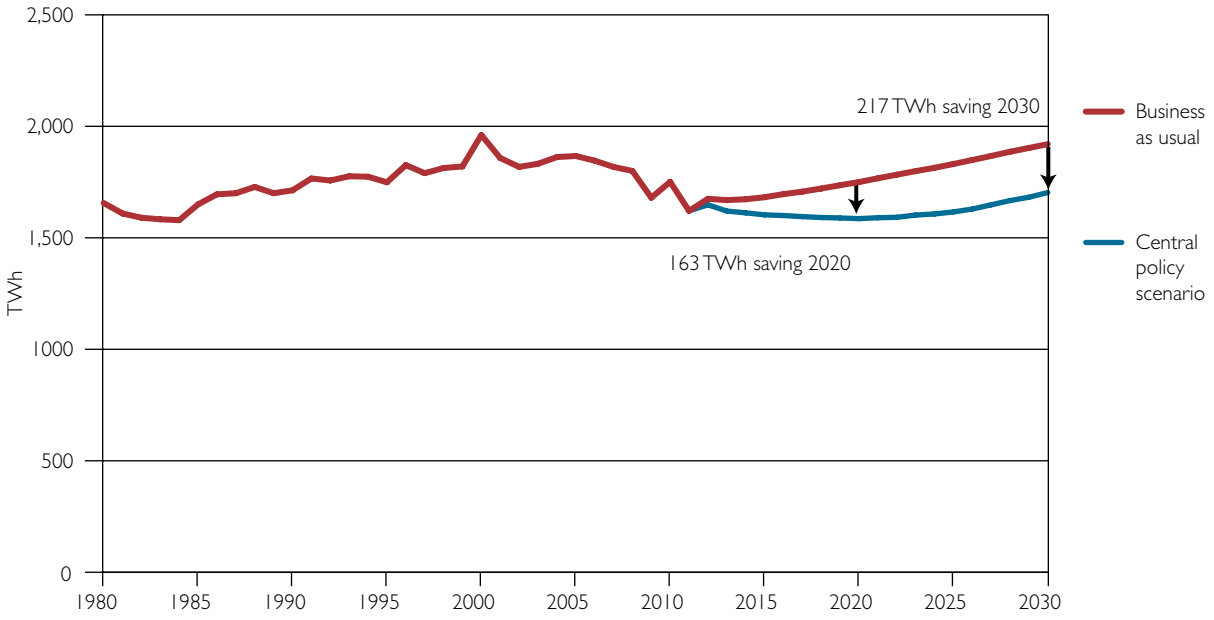
Box 5: Central Government Departments – 2010/11 10% carbon emissions reduction target

In May 2010 the Prime Minister announced that central Government would reduce its carbon emissions by 10% within 12 months. This target spanned 3,000 central government office buildings and was met by a combination of managing buildings more efficiently, rationalising the estate, investment in energy efficient technologies and green information technology and changes to staff behaviour.

Within the year, a 13.8% reduction was achieved, equivalent to 104, 532 tonnes of carbon dioxide or nearly 238 million kWh of energy – an estimated saving of £13 million on energy bills. The Prime Minister has subsequently announced a new five year commitment; this time to reduce Government greenhouse gas emissions by 25% for 2014/15 compared to a 2009/10 baseline across a broader scope of the central government estate and from business-related transport.

25. In terms of energy consumption, the Carbon Plan scenarios translate to a range from a 1% in absolute final energy consumption from 2011 to a 33% decrease. Again, Figure 4 shows that the UK is well on course to achieve this trajectory in the short term but without further policy action energy consumption will rise again in the 2020s[28]. As well as taking action now, we need to set the direction for this in subsequent decades as it will take time for the energy efficiency market to mature. This strategy is the first step.

Figure 6: Projected UK final energy consumption 2000-2030[29]



28 The DECC energy and emissions projections only take account of policies for which funding has been agreed and that are sufficiently well developed to allow robust estimates of future savings to be provided. Therefore the projections for the 4th carbon budget (2023 – 2027) onwards represent a baseline scenario in which the government takes no further action to reduce energy demand or increase take up of renewables outside the power sector. Therefore the projections for 2030 do not do not represent the government's view of what we expect to happen. The government does plan to take further action to reduce energy demand and remains fully committed to meeting its carbon targets.

29 Energy Efficiency Statistical Summary http://www.decc.gov.uk/eedo

26. The existing policy package is due to deliver savings in greenhouse gas emissions of 134 $MtCO_2e$ (24%) in 2020 and 161 $MtCO_2e$ (28%) in 2030, relative to business as usual. In 2020 33% of these savings are due to improved energy efficiency with the remaining coming from switching to low carbon energy sources for example nuclear power and road transport biofuels. The impact of current policies that reduce energy demand are assumed to taper off in impact after 2022, (the fourth carbon budget period) and by 2030 the share of energy efficiency policy impact falls to 31%. In the non-traded emissions sector[30], energy efficiency policies make up 59% of the savings in 2020 and 75% of the savings in 2030.

27. **A sustainable and secure energy system:** Through reducing energy consumption we improve the UK's energy security[31]. A more energy efficient UK will have lower exposure to international energy market price rises and volatility. There can also be specific benefits to the energy system of decreasing demand as it reduces the long-term need for investment in additional infrastructure that would have otherwise been required. This has the potential to reduce the overall cost of our energy generation framework in the future.

Box 6: Implementing the 2012 EU Energy Efficiency Directive

In June this year, and with active support from the UK, Member States agreed the new Energy Efficiency Directive. This is due to be published shortly and will need to be fully implemented by Spring 2014. The Directive is a significant step forward by the EU as it looks to meet its target to reduce primary energy consumption by 20% by 2020 against business as usual projections. The Directive includes obligations on Member States to:

- set themselves **indicative targets for primary energy consumption in 2020**, taking into account the EU's overarching 2020 target;
- meet annual targets for **building renovation**, or equivalent energy savings, on the central government estate;
- **meet binding energy saving targets** through the deployment of a supplier obligation and/or equivalent policy measure/s;
- require non-SME enterprises to undergo **energy audits every four years**;
- ensure developers of new generation installations over 20MW undertake a cost-benefit analysis of the case for developing a **Combined Heat and Power** (CHP)Plant; and
- report regularly to the European Commission through a series of periodic **National Energy Efficiency Action Plans**.

EEDO will lead on the implementation of this Directive, working with other Departments and Devolved Governments to deliver its requirements cost effectively. For example, we will consult on the implementation of the requirement for large commercial building energy audits during the first half of 2013.

30 Emissions that are not covered by the EU Emissions Trading System.
31 See forthcoming Energy Security Strategy, DECC.

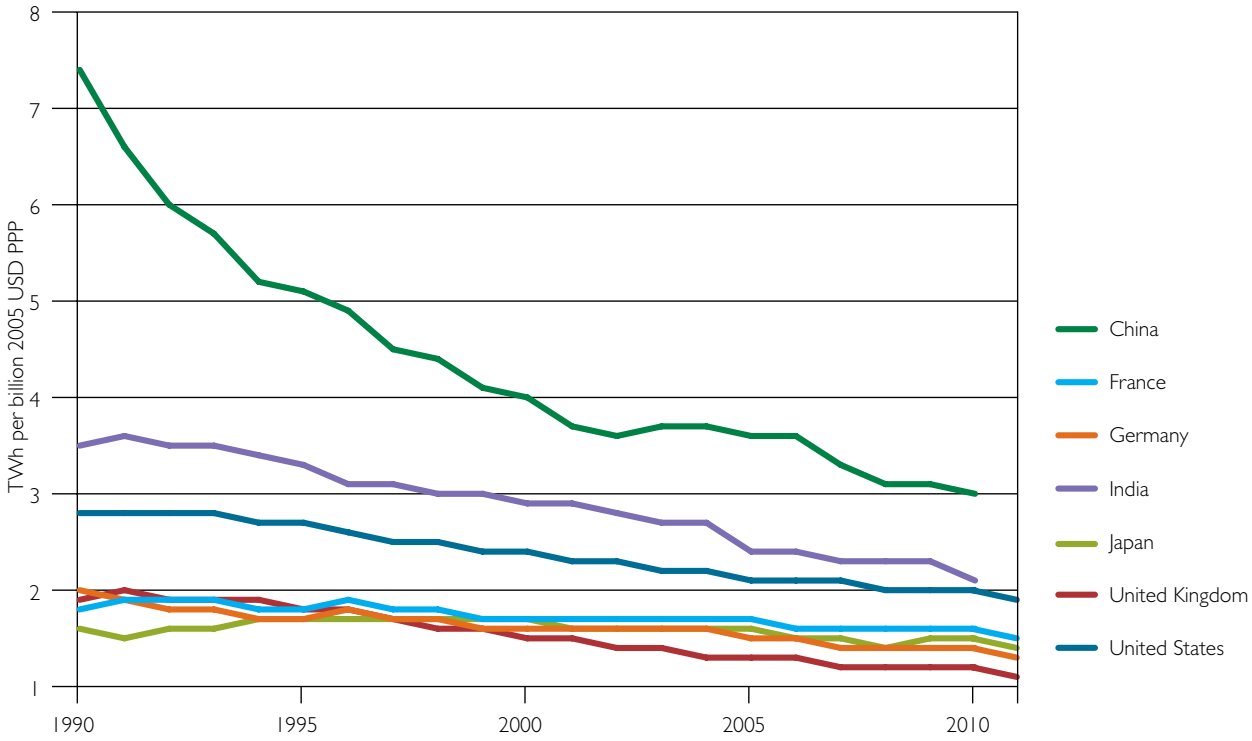
Our ambition for improving energy efficiency

28. **The UK:** Success for EEDO will be delivering energy demand reduction beyond that which current energy efficiency policies are projected to deliver, maximising the performance of the existing framework and going further. The above comparison against what is required to meet our carbon budgets is one indicator of how important achieving this will be, particularly from 2020 onwards.

29. Current projections show that, with no additional energy efficiency policies from 2009, final energy consumption had been projected to rise from the 2010 level by 168 TWh over the next 20 years[32]. However, the existing policy package is due to deliver savings of 163 TWh (9%) in 2020 and 217 TWh (11%) in 2030 relative to the business as usual projection. This means by 2020 current energy efficiency policy should save the UK the amount of energy equivalent to that currently used by about nine million homes in a year or the output from 19 power stations[33]. A full analysis of energy efficiency indicators is shown in section 2 of the Statistical Summary[34].

30. **European Union:** The EU has a target to save 20% of its primary energy consumption by 2020, against the EU's 2007 business as usual projection through improvements in energy efficiency. But the Commission estimated in 2011 that existing policies in member states meant that the EU was only on track to get half way towards that target. Under the Danish Presidency, the Commission therefore developed an Energy Efficiency Plan, published on 8 March 2011, with the aim of closing this

Figure 7: Primary energy consumption per unit of GDP (PPP adjusted)



Source: IEA

32 DECC Energy & Emissions Projections, October 2012, http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx#2012
33 Assumption of a power station with 1 GW capacity operating full-time.
34 Energy Efficiency Statistical Summary http://www.decc.gov.uk/eedo

gap. The Plan contained a range of proposals for action across all sectors of the economy to which the EU Energy Efficiency Directive is intended to give legislative effect. It will also replace and repeal two existing Directives: the Co-generation Directive (2004/8/EC) and the Energy End Use Efficiency and Energy Services Directive (2006/32/EC).

31. **International:** Although there is significant further potential, the UK has already made reductions in energy intensity and is now one of the least energy intensive economies in the developed world. Over the last 10 years UK energy intensity has fallen by 27%, compared to 16% in Japan and United States, 20% in Germany and 14% in France. July 2012 analysis by the American Council for an Energy Efficiency Economy (ACEEE) shows that, of the 12 largest world economies, the UK is performing best overall on energy efficiency indicators[35].

32. This is in part due to the current structure of our economy, with strong services and financial sectors, although we also have a manufacturing sector that is roughly comparable as a proportion of GDP to countries such as France and the US. Nevertheless, there is still significant un-tapped potential for further energy savings when compared to some others, particularly around domestic energy use and in some industrial sectors and we want the UK to take the lead.

33. The advantages of energy efficiency have been well documented[36] but, to increase our understanding further, **EEDO will collaborate with international partners to support the International Energy Agency (IEA) project on further exploring the wider benefits of energy efficiency**.

The barriers to deploying energy efficiency

34. While the evidence suggests that there is significant potential for cost-effective investment in energy efficiency, this potential is not being realised in full. The existence of market failures and other barriers to energy efficiency means that we see less investment in energy efficiency than is best for the UK. To meet this ambition, we need to address the barriers to energy efficiency.

35. While it is possible to characterise these market failures and barriers in a number of different ways, in this Strategy we have categorised them as issues relating to an embryonic market, information (its provision and lack of trust), misaligned financial incentives, and behaviour barriers that mean energy efficiency is undervalued. While we have separated out these groups of barriers, they are often inter-related and work together to reduce investment in energy efficiency. Solving one area of market failure would not be enough on its own to realise the full potential for energy efficiency. At the same time, although there may be overlap, if you were to remove one of these barriers from the list, there would be a notable gap in the analysis.

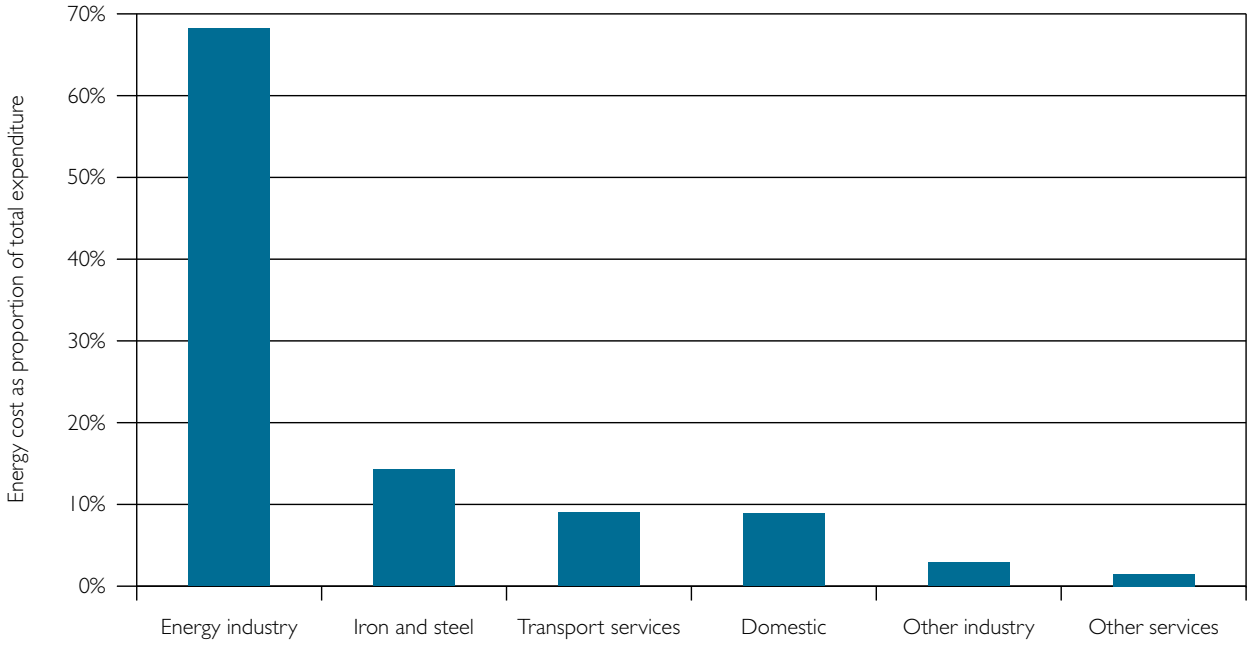
36. Each of the four barriers described below is considered in dedicated annexes to this strategy, showing progress that has already been made by existing policy and identifying further ways in which we can address the energy efficiency potential in the UK economy. Policies often tackle more than one barrier and where they do this is reflected. Where barriers or policies take a different form in different sectors, this is also described.

- **Embryonic markets**: We do not need to create an energy efficiency market, but we want to see it grow and become 'mainstream'

35 The ACEEE 2012 International Energy Efficiency Scorecard, http://www.aceee.org/sites/default/files/publications/researchreports/e12a.pdf

36 The colour of growth: Maximising the potential of green business, CBI, July 2012.

Figure 8: Estimated energy cost as proportion of total expenditure, by UK sector, 2009 (Experimental analysis)[37]



activity, particularly use of different forms of financing. While there are examples of companies focused on helping domestic and non-domestic consumers improve energy efficiency, the market remains underdeveloped, especially in comparison with the United States. Energy efficiency product and services companies could have much greater penetration into the wider commercial, industrial and public sectors, given the benefits they offer. In the absence of a developed market there is relatively little expertise on either the demand or supply side for energy efficiency investment. This constrains the development of financial products to support energy efficiency investment and leads to high transaction costs. Without a catalyst to drive development of the market, the costs around investing in energy efficiency will remain high, reducing cost-effectiveness.

- **Information:** One of the key characteristics of the embryonic market is that there is a lack of access to trusted and appropriate information. Energy efficiency improvements are often made through purchasing upgraded equipment of which energy efficiency may only be one characteristic. Where information is available, it may be generic, and not tailored to specific circumstances, which means that potential investors are not in a position to assess the benefits of an energy

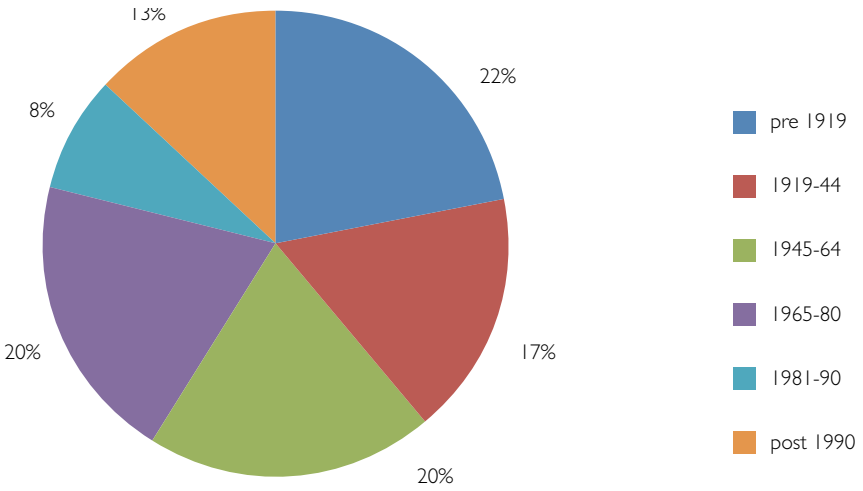
37 DECC analysis of Office for National Statistics data. Data for the non-domestic sector sourced from secondary analysis of the 2009 Supply Use Tables produced by the Office for National Statistics (ONS) as part of the National Accounts. Data for the domestic sector is sourced from the 2009 Living Costs and Food Survey. Private transportation is included in the domestic sector. The transport services sector is defined as organisations which identify their primary business activity as transportation.
This is experimental analysis and as such each sector has an associated margin of error. Total expenditure for the non-domestic sector is defined as final consumption expenditure plus the compensation of employees and non deductable VAT. Gross capital formation has been excluded from this definition of expenditure. Total expenditure in the domestic sector includes VAT.

efficiency investment. Financing of energy efficiency projects can be undermined by the absence of standardised monitoring and verification processes which means that the benefits of energy efficiency investments are not trusted. While information is available about overall energy consumption both in the home and in business settings, it can be difficult to relate that back to individual activities to identify opportunities to make energy efficiency improvements. In the absence of clear, trusted information, many individuals do not prioritise energy efficiency investments.

- **Misaligned financial incentives:** It is not always the case that the person who is responsible for making energy efficiency improvements will receive the benefits of there actions. For example, in most cases commercial rented tenants are responsible for their own bills and therefore it is in their interest to reduce the bills, but contractual arrangements around landlord/tenants or facilities management may inhibit investment. Landlords are unlikely to invest unless they will realise the benefits in monetary terms. On a societal level, wider benefits such as security of supply or emission reductions are not directly felt by those making energy efficiency investments and, as a result, the decision to invest is based only on the benefits directly received. Therefore, energy efficiency investments are not prioritised as they might otherwise be. Figure 8 shows that, across the entire economy, energy costs can be a relatively small proportion of costs for many sectors, but in aggregate that energy use is a huge ask of our energy system.

- **Undervaluing energy efficiency:** The lack of salience of energy efficiency increases the impact of hassle costs and behavioural barriers. Energy efficiency changes may involve significant hassle costs for those carrying out the investment, which increases the costs of the investment. For example, disruption caused by building works or disruption to production lines. Energy efficiency improvements may not be seen as strategic for a company and therefore not prioritised. For example, outside of the energy intensive industry sectors, energy bills are only a small proportion of business costs. If the relative gain is small, then the hassle costs can act as a significant barrier, especially if there is uncertainty around the benefits of the investment. While hassle costs are not a

Figure 9: Age profile of homes in England: 2010[38]



38 DCLG English Housing Survey.
http://www.communities.gov.uk/housing/housingresearch/housingsurveys/englishhousingsurvey/

market failure, they compound the impact of other behavioural barriers, reducing investment in energy efficiency. This is often why companies are reluctant to invest in energy efficiency, seeking short payback times, even if a project is cost-effective at usual interest rates. Wider economic uncertainty is also reducing willingness to invest.

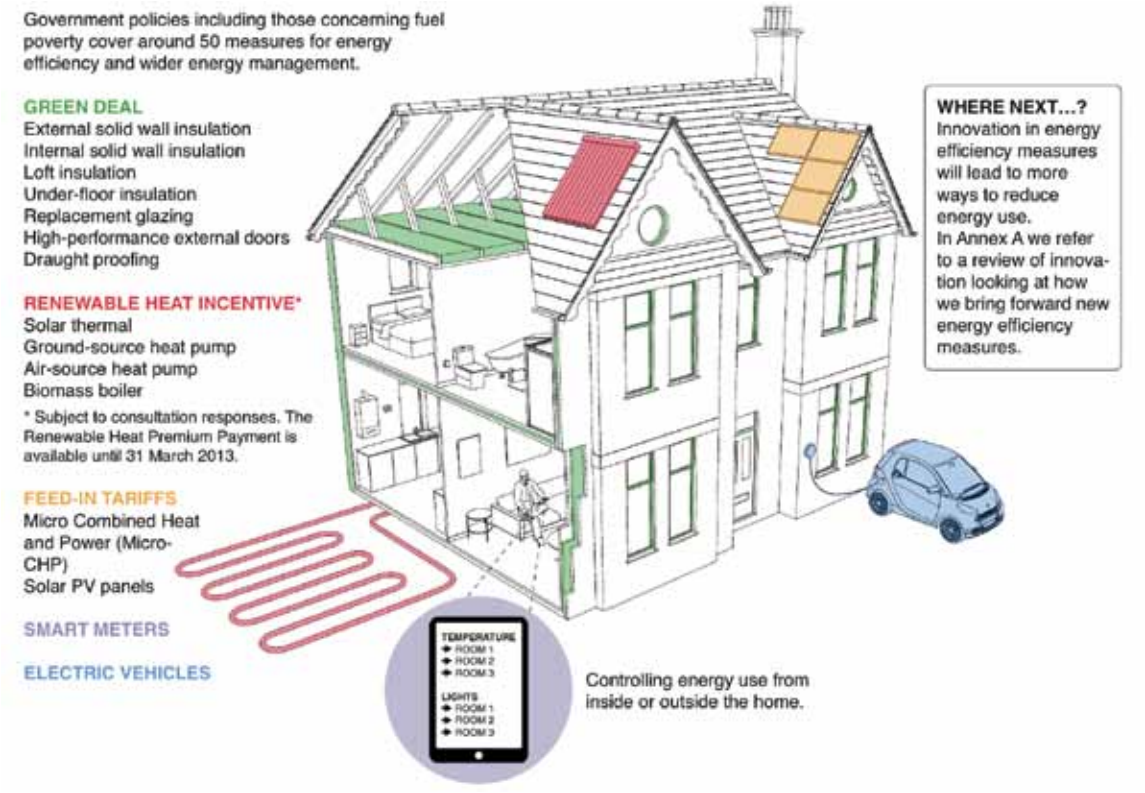
Maximising the potential of existing schemes

37. Many existing schemes address the above barriers and our strategy is to maximise their potential impact. This decade will see a revolution in buildings energy management. Never before have household and business consumers been supported by such a range of Government measures in order to achieve the highest standards of improved energy use. **We will have the Green Deal, Renewable Heat Incentive (RHI), Feed in Tariffs (FiTs) and Smart Meters all available at the same time.** This an era of new opportunities for consumers but also the supply chain and we have discussed with many businesses their plans for the future.

38. Although at least 14 million homes in Britain are not properly insulated, out of a total of 27 million[39]. Our housing and building stock is incredibly varied and high proportion is very old. As of 2010, 39% of homes in England were built before the end of World War II. New buildings are built to higher standards than ever before but it is possible for older housing to catch up through retrofitting and microgeneration approaches.

39. It used to be that images of buildings where people need much less energy and managed every aspect of energy use were set in the future, or seen in a very high end retrofit examples on TV. But the changes we

Figure 10: 19th century house... 21st century energy management



39 Analysis from DECC Insulation Statistics (July 2012) http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/en_effic_stats/home_ins_est/home_ins_est.aspx

are bringing forward will make this the norm and make it affordable to millions.

40. Figure 10 shows the extensive range of measures that will be supported by the emerging suite of schemes. Of course, different people will want to make changes at different times and some will want to do as much as they can together. Both are possible.

41. To realise the potential of the schemes to change the energy management of buildings requires a number of elements to be right for each scheme individually. A key challenge and current priority of the Energy Efficiency Deployment Office is understanding how the schemes interact, can work together and how we might build on them for the future.

42. We are currently focused on the year ahead and mapping the '**customer journey**', exploring the further linkages between existing policies, and working with the supply chain to unlock the opportunities around a joined up offer for the consumer. For example, could packages be developed that take advantage of the Green Deal, FiTs and/or RHI. We need to understand how different types of consumers first become aware of the options that are available to them and the steps that they need to take. Initial market signals suggest that some in the market will deliver packaged options, but it will be necessary to ensure that the whole policy landscape does work together.

43. To further facilitate this **all related future policies will give particular consideration to energy efficiency conditionality**. For example, as part of the September 2012 RHI consultation on expanding the scheme[40], we are consulting on minimum energy efficiency requirements for district heating, commercial space, industrial space and water heating as well as for householders.

44. The National Planning Policy Framework[41,42] we published earlier in the year sets out how planning should support the transition to a low carbon future. The Framework looks to local councils to, for example, plan new development in locations and ways which reduce greenhouse gas emissions and, when determining planning applications, expect new development to take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption. We have also made it clear that local councils in their planning should actively support energy efficiency improvements to existing buildings.

45. To deliver even more savings from these and other policies in the coming years EEDO will continue working across Government and with the Devolved Administrations to explore ways in which policy improvements can divine greater energy efficiency. This will include rationalisation and ensuring greater mutual reinforcement of policies in the medium- to long-term. It will also mean ensuring that these demand reduction policies are aligned.

An energy efficient future

46. We all have a stake in ensuring that we maintain security of energy supply and avoiding dangerous climate change. It is important that we all consider what opportunities we might take to work towards these national and, particularly in the context of climate change, international goals. Energy efficiency provides such an opportunity and, at the same time, an opportunity to save money and improve productivity. As the Carbon Plan makes clear,

40 Renewable Heat Incentive Consultation Documents, Department of Energy & Climate Change, September 2012: http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx

41 National Planning Policy Framework, Department for Communities and Local Government, March 2012: http://www.communities.gov.uk/documents/planningandbuilding/pdf/2116950.pdf

42 Scotland has its own planning framework: http://www.scotland.gov.uk/Topics/Built-Environment/planning/National-Planning-Policy/npf/NPF3

our broader strategy is to focus on energy efficiency now, recognising that early demand savings are a no regrets, cost effective way of reducing the effort we will later have to make in decarbonising the energy system.

47. Through to 2030 there will be significant changes to the way we use energy. For example, the way we heat our homes and the way we power our transport as we transition away from fossil fuels. Processes will be more energy efficient, but energy use is still set to rise. We need to exploit existing opportunities to bear down on that potential energy use.

48. There are good examples of progress in the last decade. For instance, by 2020, products policy being implemented in the UK is projected to save 11% of electricity demand. There has been the impact of advances in information technology, including basic heating controls that have now become digital and can now be controlled via smartphone. We need to make best use of these advancements if we are to further increase the country's energy efficiency. It is these things that can help us build the homes of the future, such as that in Figure 10.

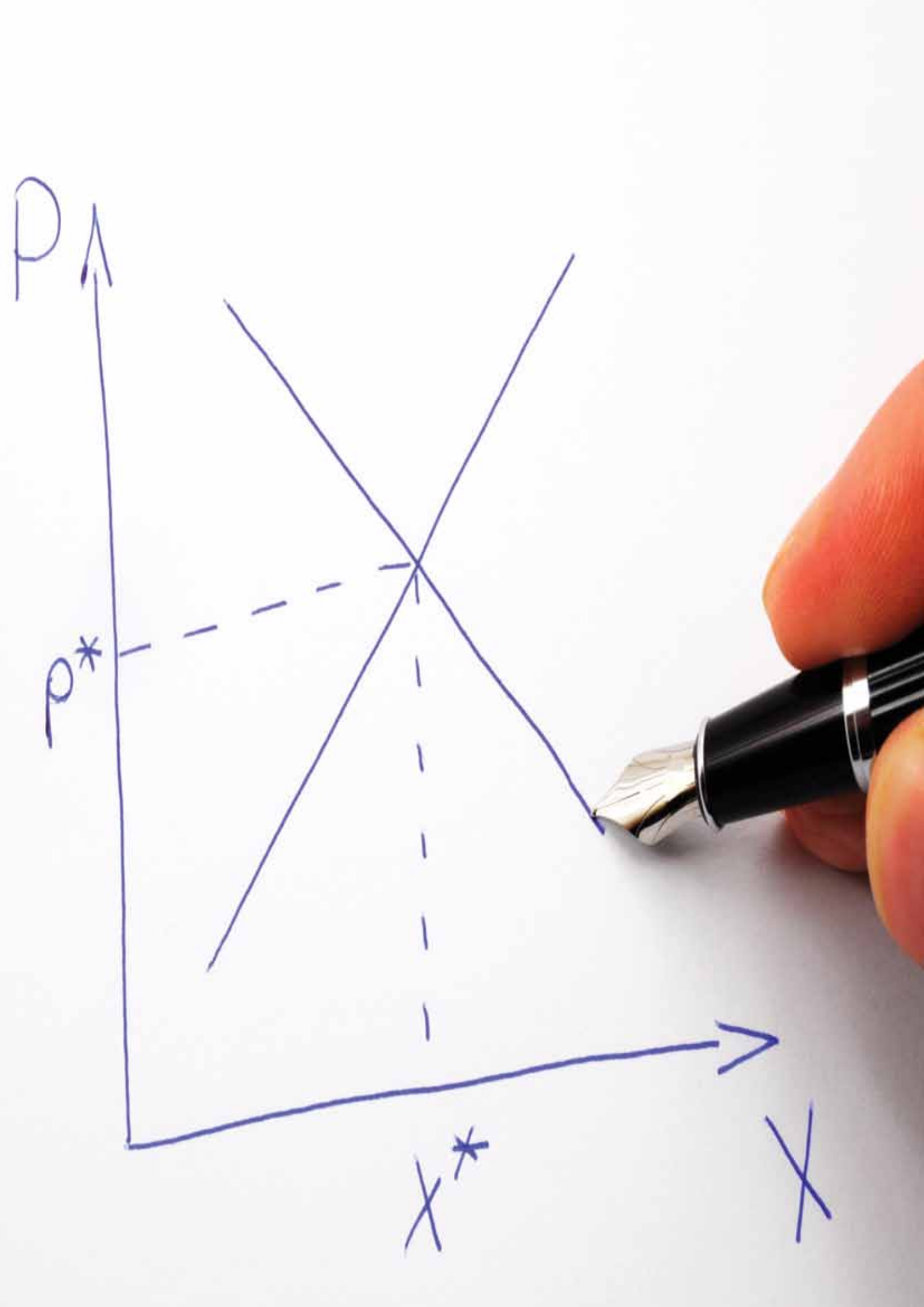
49. This Strategy has identified the significant energy efficiency potential and the multiple benefits that could arise from achieving that potential. We need to invest now if we are to overcome the barriers to achieving an energy efficiency market that is mainstream and we have already described actions that we are taking now (see box 1 and Annexes A-D of this strategy).

50. **Looking ahead to the coming year, EEDO's work will include:**

- leading the **implementation of the EU Energy Efficiency Directive**, including consulting on the introduction of **energy audits** for large commercial enterprises in the first half of next year;
- working with the other Government Departments and the Devolved Administrations to further develop the **evidence base** against the gaps identified as part of the analytical work that supported this strategy;
- developing a series of **sector by sector guides** on what benefits increasing energy efficiency can bring to consumers by next summer;
- ensuring policies combined to deliver a well integrated **'customer journey'** in the energy efficiency market;
- considering further options for **maximising the impact of existing policies** and **addressing the additional energy efficiency potential** that has been identified;
- continuing to accept views and ideas through the **eedostrategy@decc** email address[43]; and
- **reporting alongside next year's Annual Energy Statement** on progress against this Energy Efficiency Strategy.

51. Improving the way we use energy is essential to our future economy and future way of life. We have the opportunity to lead the world in becoming more energy efficient and we must take it.

43 eecostrategy@decc.gsi.gov.uk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Annex A: Barrier: Embryonic markets

Embryonic markets

Definition: We do not need to create an energy efficiency market, but we want to see it grow and become 'mainstream' activity, particularly use of different forms of financing. While there are examples of companies focused on helping domestic and non-domestic consumers improve energy efficiency, the market remains underdeveloped, especially in comparison with the United States. Energy efficiency product and services companies could have much greater penetration into the wider commercial, industrial and public sectors, given the benefits they offer. In the absence of a developed market there is relatively little expertise on either the demand or supply side for energy efficiency investment. This constrains the development of financial products to support energy efficiency investment and leads to high transaction costs. Without a catalyst to drive development of the market, the costs around investing in energy efficiency will remain high, reducing cost-effectiveness.

What is already happening to address this barrier?

- The Green Deal and Energy Company Obligation
- The CRC Energy Efficiency Scheme
- Climate Change Levy/Climate change Agreements
- Salix Finance Limited
- The UK Green Investment Bank

What more are we doing now?: Actions include:

- Publishing guidance on financing energy efficiency for the public sector;
- Initiating an assessment of compatibility of energy efficiency investments with the public sector budgeting framework;
- Taking the RE:FIT programme, which facilitates the public sector use of the ESCO market, nation-wide;
- The Electricity Demand Reduction project;
- Reviewing the way that new innovative energy efficiency measures are reviewed and accredited.
- Announcing a research project with ENWORKS to understand the process, costs and benefits of undertaking energy efficiency projects;
- Announcing three new 'energy efficiency' Technology Innovation Needs Assessments (TINAs); and
- Sponsoring three new energy efficiency Green Business Awards.

A.1 This strategy describes the multiple benefits that improving energy efficiency can bring to individuals, businesses and the UK. The extent of these economic, social and environmental benefits, and the nature of the barriers, mean there is a clear role for Government in stimulating this sector, which already accounts for about 136,000 jobs in the UK[44].

A.2 Government can build awareness of the offer to the consumer that the energy efficiency sector can deliver. It can provide guidance and information to build trust in the market. It can also bring together different players, facilitating discussions between aggregators of demand and the supply chain and/or finance streams. We need to do this in order to develop a market that actively and effectively seeks out cost effective energy efficiency potential and makes a profit from it.

A.3 The energy efficiency investment market is growing but, given that the technology is available to make cost effective low carbon investments, it is small relative to the size of the potential opportunity. With the notable exception of the domestic insulation market following CERT, the market has not grown sufficiently over the years and there are no well-developed financial products for investing in energy efficiency. This has lead to high transaction costs as contracts for projects have to be developed each time.

A.4 Further, in the absence of large scale intermediaries promoting energy efficiency investments the market remains small. Without a catalyst to promote greater interest in energy efficiency investments, there is the risk of a continued cycle of underinvestment where neither the demand or supply side develops. This would mean that transaction costs remain high, and innovations in products and business models do not occur.

A.5 The UK needs an energy efficiency sector that individuals and businesses are comfortable operating within. Energy efficiency can be seen to be complex, but there are many other services in our economy that are arguably more complicated in design that are also accepted as part of life. For example, securing insurance or buying a house. We need to develop this market so it is also 'accepted' and this annex considers what is being done against the three elements of the market that will help deliver this: consumers, finance and the supply chain, including innovation.

Existing activity to help consumers

A.6 If we are to connect demand with supply we need to ensure that consumers have easy access to the market. This means setting up clear mechanisms, such as the Green Deal, by which they can take advantage of increased energy efficiency.

The Green Deal and the Energy Company Obligation (ECO)

A.7 The Green Deal and the Energy Company Obligation (ECO) provide a step change in the way consumers buy energy efficiency improvements. Focused at stimulating and growing a sustainable market these will replace a number of policies that are coming to an end this year. The Carbon Emission Reduction Target (CERT), Community Energy Saving Programme (CESP), Warm Front and fuel poverty programmes run by the Devolved Administrations have all played their part in encouraging households to take up energy saving measures, often with particular focus on helping vulnerable households. For example, Warm Front, which has been aimed at tackling fuel poverty, has assisted 2.3 million households across England since its inception in June 2000. We also estimate that 9.7million properties have benefitted from at least one major insulation measure under EEC, CERT and CESP to April 2012[45].

44 K-Matrix, Low Carbon and Environmental Goods and Services data (2010-11).
45 Source: DECC Energy Trends, September 2012.

A.8 The Energy Act 2011 includes provisions for the new **Green Deal**, which intends to reduce carbon emissions cost effectively by improving the energy efficiency of properties in Great Britain. The Green Deal will enable private sector companies, or other organisations, to offer consumers energy efficiency improvements to their homes and businesses, some or all of which can be repaid over time via the electricity bill under a Green Deal Plan, with repayments being no more than what a typical household should save in energy costs.

A.9 The Green Deal attaches to the electricity meter of the property. It is the current bill payers of a property, usually the owners or tenants, that will make the subsequent repayments. Responsibility for these repayments will be transferred to the subsequent bill payer at the change of ownership or tenancy. Green Deal assessments and the installation of energy efficiency measures will be carried out by individuals that are independently accredited and authorised[46].

A.10 The **Green Deal Quality Mark** will allow businesses to demonstrate they have met Green Deal standards, and will protect consumers. All authorised Green Deal participants will have to display the Green Deal Quality Mark to demonstrate they comply with the required Green Deal standards. This will be vital for protecting customers from any rogue traders.

A.11 The Green Deal is open to both domestic and non-domestic customers and is designed to be similar in its delivery to each. The assessment process is expected to be more detailed for non-domestic customers. This is because the use of non-domestic properties can vary greatly. There is a single list of qualifying energy efficiency improvements for domestic and non-domestic buildings. However, in practice only the improvements appropriate for the building in question will be recommended during the Green Deal Assessment. Since 1 October 2012 Green Deal assessors, installers and providers have been able to get accredited and registered for business, and to begin to put in place concrete plans on the ground as the initial market develops. Authorised Green Deal providers will be able to offer Green Deal plans from late January 2013. The number of offers available is expected to build as more providers enter the market.

A.12 Government will play its part in ensuring the Green Deal is a success through a national programme of activity to explain and build confidence in the Green Deal. For example, DECC is committed to working with Green Deal financiers and providers to help them deliver the lowest possible cost of finance for the Green Deal. This has included working with a range of private sector parties including a consortium called the Green Deal Finance Company which is looking to allow Green Deal Providers to access low cost capital by aggregating loans and refinancing them on the open market.

A.13 Government understands that changing behaviour in the challenging area of energy efficiency is a complex long term objective. The policies we have developed to increase energy efficiency overall acknowledge in their range and in their design that one size does not fit all. The Green Deal is at its heart a market driven initiative and we believe that participants are best placed to leverage their customer knowledge and brands to provide and promote services people want. Moreover, the Green Deal will offer different packages of measures to people dependent on property type and work already done and is not a single-action or time limited programme.

46 The Green Deal also addresses misaligned incentives as discussed in Annex C.

A.14 We have used behavioural theory and conducted research to inform policy development and the marketing approach for Green Deal. But we will support market development strongly though a programme with three areas of focus:

- We will **engage with the consumer**. We will look to create a 'movement' to drive energy efficiency by: focusing initially on the Green Deal Quality Mark; building on the recent 'LEAF' community initiative; and the provision of advice through the impartial helpline and website.

- Contact with consumers will also include working through **intermediaries**. Key to this will be the role of local authorities (LAs). To this end in July 2012 we issued new statutory guidance to English local authorities under the Home Energy Conservation Act 1995, which recognises local authorities' ability to improve the energy efficiency of all residential accommodation in their areas including, where appropriate, through the Green Deal and ECO. The guidance encourages LAs to work with local partners including social housing providers and community organisations to help drive early demand and implement cost-effective energy efficiency improvements.

- Our approach **supports take-up of wide range of measures**, including:

  – the **Energy Company Obligation (ECO)**, which will help alleviate fuel poverty and drive further demand for insulation and other energy efficiency improvements. Energy companies will be required to deliver energy efficiency measures to households through ECO, through which around £540m is expected to be spent annual delivering insulation measures to low income and vulnerable households and those in deprived areas. For example, part of the ECO scheme has been specifically designed to provide 'Affordable Warmth' to low income and vulnerable households, through heating and insulation measures[47,48];

  – **£125m Green Deal Cashback Scheme, available from January 2013**, to encourage early take up of Green Deal;

  – the Energy Act 2011, which enables Government to regulate to help ensure the take up of cost effective energy efficiency improvements in the **Private Rented Sector**[49];

  – better information through an improved **Energy Performance Certificate (EPC)**[50];

  – **smart meters** mass-rollout from 2014, where energy suppliers will have to direct consumers to impartial sources of energy efficiency advice as part of the installation process, such as generic information about the Green Deal[51]; and

47 On 6 June 2012, the Scottish Government announced plans for a National Retrofit Programme to upgrade Scotland's stock, tackle fuel poverty and reduce carbon emissions. The programme will prioritise fuel poor areas first and cover the whole of Scotland in around 10 years and will see local authorities play a central role in the delivery of the Programme.

48 In Wales, Nest replaced the Home Energy Efficiency Scheme (HEES) from 1 April 2011. The programme is managed by British Gas, working with the Energy Saving Trust (EST). Nest energy improvement packages provide householders living in the most energy inefficient properties with a package of support that will help take them out of fuel poverty and reduce the risk of them becoming fuel poor in the future. Arbed is the Welsh Government's strategic energy efficiency investment programme. Arbed takes a 'whole-house' or 'consider-all-options' approach to domestic energy performance to tackling fuel poverty, supporting social cohesion and aims to achieve economies of scale wherever possible. Arbed supports energy efficiency measures and renewable energy/heat technologies in specified homes within agreed areas/communities.

49 See Annex C for more detail.

50 See Annex B for more detail.

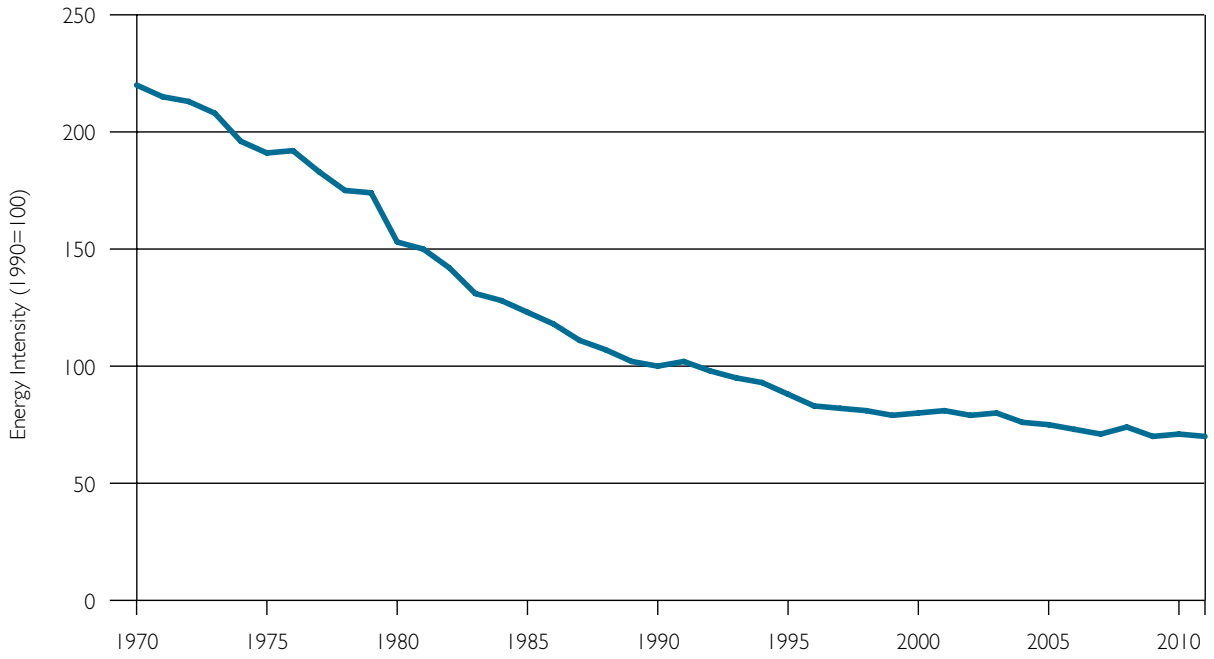
51 See Annex B for more detail.

– considering how to make **FiTs and RHI** conditional on energy efficiency.

A.15 Furthermore, a **new Energy Saving Advice line**, run by the Energy Saving Trust, was launched in April 2012 across England and Wales provides information and advice to both domestic and non domestic customers (including businesses, the public sector and the third sector) on the take up of energy saving measures in their properties. Launched October 2012, the advice line will be essential to the Green Deal, supporting consumer confidence by providing impartial advice and helping customers find authorised Green Deal participants. It will also act as an entry point for those who may be eligible for extra support through ECO. There are separate arrangements for advice and support in Scotland which will support the delivery of the Green Deal and energy efficiency more broadly[52].

A.16 As outlined in the overview, Professor Hills undertook **an independent review of fuel poverty** in March 2011, and the final report was published in March 2012. In his report, Professor Hills made it clear that accurate measurement was a prerequisite for effective policies and that the current indicator of fuel poverty has misrepresented trends and masked the impact of policy interventions. As part of these findings, Professor Hills was clear that targeted energy efficiency schemes are one of the most effective means of tackling fuel poverty. On the 18 September 2012, the Government published a consultation covering our proposals for a new definition of fuel poverty to cover England, based on Hills proposals, and seeking views on both the overall framework and the methodology used. The consultation closes in November 2012, and we intend to publish an updated strategy for tackling fuel poverty in England in 2013.

Figure 11: Energy intensity of UK industry: 1970 to present[53]



52 Energy Saving Scotland Advice Centre network on 0800 512 012 or at www.greenerscotland.org; business advice – http://scotland.gov.uk/Topics/Business-Industry/Energy/Action/energy-efficiency-policy/ResourceEfficientScotland

53 Energy Consumption in the UK, July 2012, table 4.5: http://www.decc.gov.uk/en/content/cms/statistics/publications/ecuk/ecuk.aspx

Stimulating the energy efficiency market in commerce and industry

A.17 There is consensus that energy intensive industries have made significant progress in the way that they use energy over recent years. This is illustrated by high level trends in energy use per unit industrial production. This high level trend, based on developments since the 1970s is illustrated by the chart below showing energy use per unit industrial production. The energy intensity of the industrial sector in 2011 was 32% of its 1970 level.

A.18 Innovations within industrial processes[54] and the installation of CHP plants has played an important role in this improvement which has largely been driven by the rising cost of energy. Analysis suggests that there is further potential for the energy intensive industries[55], for example in terms of smaller items of machinery, but the policies in place, coupled with price drivers, largely provide a framework for achieving this.

A.19 The market in energy efficiency services and energy efficient goods for commerce and industry has been stimulated by policies such as **Climate Change Agreements**, the **CRC Energy Efficiency Scheme** and the **EU-Emissions Trading Scheme**[56]. By raising the importance of energy efficiency in larger organisations, these schemes have created business opportunities for those with expertise in energy monitoring and measurement, energy management as well as specific energy efficient products.

Improving energy efficiency in the public sector

A.20 As described in box 5, central Government has been taking a lead in achieving greater energy efficiency. All Central Government departments are mandated to participate in the CRC Energy Efficiency Scheme, including their executive agencies and certain NDPBs. Other public sector organisations participate if they meet the qualifying criteria.

A.21 Within one year, following the Prime Minister's May 2012 announcement, a 13.8% reduction in CO_2 emissions had been achieved, equivalent to 104,532 tonnes of carbon or 238 million KWh of energy or a saving of £13 million.

A.22 Since 2004, **Salix Finance Ltd**, currently funded by DECC for England and by the Scottish and Welsh Governments via the Carbon Trust, has operated an interest free loan scheme for public sector organisations. Loans are provided for energy efficiency projects with

CASE STUDY 1: Ireland – The Large Industry Energy Network

Facilitated by the Sustainable Energy Authority (SEAI), the Large Industry Energy Network (LIEN) is a voluntary grouping of companies that work together to develop and maintain robust energy management. **140 of Ireland's largest energy users are members of the LIEN, accounting for over 60% of Ireland's total energy requirement**. Regular workshops, seminars and site visits provide a forum through which members keep up to date on best practice and new technologies.

The LIEN has continuously improved its energy performance since it was formed, **member companies avoided energy costs of €60 million in 2008 alone**. Some have improved their energy efficiency by over 30% in the last decade.

54 Carbon Trust Technology Innovation Needs Assessment (TINA).
55 See Figure 1.
56 See Annex C for more detail.

a payback of less than 5 years. For every £1 invested in a project, Salix estimates that £4 is saved on energy bills over the lifetime of that project.

A.23 While small in the overall terms of UK energy saving, action taken in the public sector enabled by this scheme is projected to save around 150 GWh of energy this year, relative to business as usual[57].

A.24 Department for Education will be injecting £8m for schools into the Salix Finance energy efficiency loan scheme. This funding will be available to be committed to school energy efficiency projects in 2012/13. To ensure the maximum benefit is derived from the funding, Salix will run a targeted campaign aimed at schools and establish a number of exemplar projects.

Further activity to help consumers

Achieving more in the public sector

A.25 **Published alongside this Strategy is guidance prepared by Local Partnerships for DECC on financing energy efficiency in the public sector.** The guidance is aimed at finance directors and other public sector decision makers. Its purpose is to increase awareness of the benefits to public sector organisations of investing in energy efficiency, and provide guidance on options for funding energy efficiency improvements. The guide also provides examples of some highly successful energy efficiency projects carried out by public sector organisations, and the benefits they deliver.

A.26 A further area for scrutiny is how and whether budgeting and accounting frameworks

CASE STUDY 2: Benefiting from energy efficient ceramics manufacture

In 2004, Endeka Ceramics UK, a supplier of materials used in the manufacture of ceramic ware, embarked on **a major research and development programme to improve the energy-efficiency of ceramics' manufacture**. Using their ThermECO materials technologies, they developed both a new clay body and compatible glaze system which would reduce both the firing temperatures required (by around 100 degrees centigrade) and the number of times an item needs be fired during its manufacture. For example, from a twice firing to a single firing process.

Dudson, a major manufacturer of hospitality ware (products used by the restaurant and hotel industry) developed a new range to maximise the benefits offered by the ThermECO materials. The partnership resulted in a product range which was of the required high standard and quality expected by the customer in this competitive sector. In early 2009, Dudson were able to launch the new range claiming **a 79% reduction in carbon emissions and substantive energy savings compared to the production of an equivalent porcelain product**. Helped by these strong environmental messages the product's success has continued to grow and grow.

57 DECC Updated energy and emissions projections, October 2012.

CASE STUDY 3: Salix – The University of Bradford and CHP

Salix Finance provided the University of Bradford with a quick and relatively low risk way of financing a large scale CHP installation, significantly contributing to their carbon management plan to help them achieve a 50% reduction in carbon emission targets by 2020. Salix's £2,170,000 interest-free capital finance loan project paid back within 4.3 years, allowing **the University to go on to benefit from nearly £500,000 in annual energy cost savings.**

affect the leveraging in of investment for public sector energy efficiency retrofit, including the use of the energy services market. To help address this **DECC and HM Treasury will jointly explore the relevant government imposed standards and guidelines** and the possibility of making changes or providing further guidance to overcome any barriers, and facilitate the adoption of more standardised approaches, to financing energy efficiency retrofit by public sector organisations.

Existing activity to facilitate access to finance

A.27 Access to finance is a critical part of achieving a developed market given that energy efficiency measures need investment up front. Consumers need to know that finance is currently available, as underlined by the responses to our Call for Evidence. Investors also need to be clear as to the returns that they can expect.

Providing access to finance

A.28 In August this year, UK Green Investments (UKGI), the precursor to the **UK Green Investment Bank**, announced a commitment to invest £50m each into two specialist non-domestic energy efficiency funds managed by fund managers SDCL and Equitix. These funds are required to match the funding provided by UKGI/GIB with at least the same amount of private funding, thereby creating £200m of new funding capacity for investment into this market. The managers are required to invest the funds by April 2015.

A.29 Separately, the Green Deal has been identified as an early priority for the GIB, which may make an investment of up to £300m in one or more Green Deal financing vehicles, subject to due diligence and any such investment meeting its criteria. In early August 2012 HM Treasury also announced that Green Deal could be an early candidate for support through a guarantee. If applied, any guarantee would be used to ensure a low cost of capital to Green Deal providers that would be passed on to consumers.

Further activity to facilitate access to finance

Electricity Demand Reduction

A.30 The current **Electricity Demand Reduction (EDR) project** delivers against a commitment in the Electricity Market Reform White Paper[58] to "undertake an assessment over the coming year to determine whether DECC should take further steps to improve the support and incentives for the efficient use of electricity." This is an area that could be potentially valuable to all of us, reducing electricity bills directly and also indirectly through limiting the overall cost of the electricity system in terms of funding for new generation, transmission and distribution infrastructure.

A.31 In July this year we published an initial assessment of the potential around EDR[59].

58 DECC, Electricity Market Reform White Paper, July 2011.
59 DECC, Capturing the full electricity efficiency potential of the UK, July 2012: http://www.decc.gov.uk/en/content/cms/emissions/edr/edr.aspx

CASE STUDY 4: Germany – The KfW housing

The German government supports energy efficient building renovation and construction through a set of programmes run by the state-owned KfW Reconstruction Bank. The programmes comprise various loan and grant schemes aimed primarily at the 'whole house approach'. They established a standard for building renovation and construction which has its own label 'Efficiency House' to create transparency. The grants and loans are only given for measures that go beyond the legal minimum requirements for energy efficiency in Germany. Due to the programmes, almost every second new housing unit is now in a building that is significantly more efficient than the legal requirements.

Since it started in 2006 until 2011, the state supported the programmes with 7.8 billion Euros government funding, which financed 1.1 million loans and grants and triggered investments of ca. 108 billion Euros. During this period 2.8 million housing units have been renovated or newly constructed, additionally to over 1,350 facilities on local and community level.

The programmes have significant economic benefits. One Euro of government funding triggers 12 Euros in investments. These positive effects benefit primarily the small and medium-sized construction industries. According to KfW, the funded measures save 5.3 million tons of GHG per year over an average lifetime of about 30 years.

In 2011 alone, the KfW programmes supported the energy efficient renovation of 200,000 housing units and the construction of over 80,000 new units with a high energy efficiency standard. Investments worth 18.4 billion Euros were triggered and 250,000 jobs were created or secured for at least one year. The measures helped to decrease the output of CO_2 by 540,000 tons in 2011.

This assessment of the incentives in place to support the efficient use of electricity concluded that there was significant technical potential to make efficiency savings beyond those incentivised by existing policy. DECC has set out its intention to consult on approaches to best unlock this potential.

Encouraging the energy services market

A.32 **Energy services companies** (ESCOs) can provide a wide variety of services to customers, helping them to reduce their energy use and reducing energy costs. For example, an Energy Performance Contract might be agreed where the energy bill saving realised as a result of the installation of energy efficiency measures are shared between the ESCO and the client. Under this arrangement the ESCO would provide the upfront capital required to install the energy saving measures and carry the risk if the agreed level of savings are not delivered.

A.33 Although the ESCO market has had success in other countries, with the US market being estimated to be worth over $5 billion in 2011[60], it is only just emerging in the UK. This Government believes that this model, and others like it, can help save energy and help save businesses money[61]. However, there are issues, such as a lack of providers to insure risk on

60 The U.S. Energy Service Company Market, Pikes Research, January 2012: http://www.pikeresearch.com/research/the-u-s-energy-service-company-market

61 Achieving High Performance in the Home Energy Services Market, Accenture, December 2011: http://www.accenture.com/gb-en/pages/insight-high-performance-home-energy-services-market.aspx

either side of the deal, a lack of contract standardisation, few ways to benchmark new contracts to assess value for money, and few common standards for calculating the savings that the ESCO had delivered. We will continue to consider what options are available for facilitating the development of this market and the Energy Performance Contract (EPC) model.

A.34 **DECC is funding the initial rollout of the RE:FIT programme nation-wide** to public sector organisations and will work with Local Partnerships and the Government Procurement Service to establish this support. The Greater London Authority has pioneered the Mayor of London's award winning programme to deliver the energy efficiency improvement of the public sector estate. This is achieved through a simplified ESCO procurement framework and the provision of a RE:FIT Programme Delivery Unit team to provide technical support to projects.

A.35 The RE:FIT concept was initially piloted in 42 public sector buildings across London. These projects retrofitted energy savings measures to approximately 146,000m^2 of building space, delivering over 7,000 tonnes reduction in carbon emissions and an average 28% reduction in energy consumption identified. The total spend was £7 million with a simple payback period of 7 years. Since the success of this pilot over 100 buildings have now successfully undergone retrofits and over 50 organisations, including Local Authorities, NHS Trusts, and Universities, have committed to using RE:FIT and the project pipeline contains in excess of 300 further properties. A new RE:FIT Framework has recently been tendered which further develops the approach and enables a wide range of financing options to be used.

A.36 The success of RE:FIT and the approach taken has been recognised at major awards in both the UK and in Europe where it won the Best Technical Project at the ManagEnergy Annual Awards in 2010 and in June 2011 won the Best European Energy Services Promoter at the European Energy Service Awards.

A.37 **ENWORKS** is an organisation based in the North West of England and has an excellent track record of helping businesses to increase their profitability and reduce their carbon emissions, by improving resource efficiency. They were named NGO of the Year at the BusinessGreen Leaders Awards. In the coming months, EEDO will be carrying out **a research project in partnership with ENWORKS to understand more about the process, costs and benefits of investing in energy efficiency**.

CASE STUDY 5: ENWORKS supporting manufacturing

Fine Décor Wallcoverings, a small manufacturer in Cheshire, has **uncovered annual savings of £655,400, after receiving on-site support from ENWORKS**. These savings relate to repairing equipment, improving processes and installing modern, energy efficient technologies such as variable speed drives to the drying ovens. All this has helped them to achieve an annual cost savings of £117,800 by using energy, water and materials more efficiently, from an investment of just £35,500, with another £537,500 worth of annual savings in the pipeline.

Existing activity to support innovation and the supply chain

A.38 The energy efficiency supply chain consists of many businesses, the vast majority of which are **small or medium sized enterprises** (SMEs). SMEs have responded quickly to opportunities in the past, such as in the case of FiTs[62]. This strategy sets out the challenge and opportunity for this sector, the energy efficiency market has been limited up until now and, as policies such as the Green Deal come on stream, we need the suppliers and innovators of energy efficiency to respond.

Strengthening the supply chain

A.39 Ensuring a supply chain that is both able to deliver the quantity and quality of Green Deal/ECO installations necessary has been a fundamental part of the development of these policies. This has included working with supply side companies and trade associations to ensure they understand the opportunities for them, but also putting in place a strong consumer protection framework that will build trust in the market.

A.40 The supply chain has been involved in policy development at the outset, through stakeholder forums and workshops, as well as formal consultations. DECC has also sought to help build capacity in the supply chain through surveying key sectors and providing support to overcome any critical delivery barriers, such as to provide additional training for assessors and installers.

A.41 DECC worked with industry partners to communicate the scale of the potential market and opportunity to access Green Deal and ECO support for example by working with the **Construction Products Association** who published a document on the opportunities presented by the Green Deal and ECO in Spring 2012. DECC also hosted a series of 15 regional supply chain events across England, Wales and Scotland in order to help smaller companies understand and gear-up for the Green Deal. As the energy efficiency agenda develops we will need to maintain this dialogue.

Bringing markets together

A.42 The supply chain can also bring together policies, such as the Green Deal with those focused on deploying micro-generation and renewable heat. Decentralised energy can play its part in improving the nation's energy use as whole. For example, the same service can be achieved with less energy being drawn from either the electricity or the gas distribution networks.

A.43 The Government has set out its commitment to supporting decentralised energy through the FITs and the RHI schemes. The FITs scheme has agreed funding levels as part of the spending review until March 2015.

A.44 The expansion of the RHI continued in September this year with the publication of consultations which propose to both expand the non domestic scheme, including the consideration of minimum energy efficiency requirements for district heating, commercial and industrial space and water heating, and produce a scheme for householders with an intended launch in summer 2013[63]. There are

62 The Feed-in Tariffs (FITs) scheme is restricted to GB.
63 http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx

already grants available for renewable heat for householders, and support for social landlords and communities under the Renewable Heat Premium Payment (RHPP) scheme, set to run until March 2013.

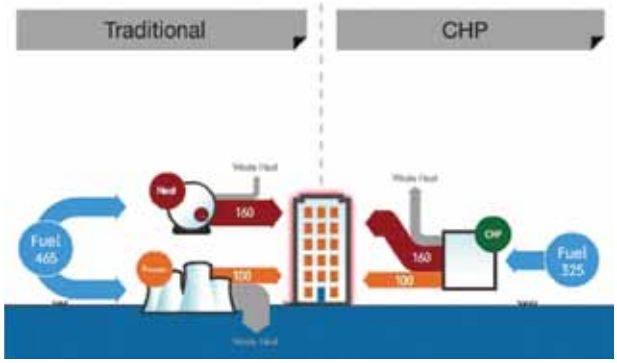
A.45 As described in the overview to this strategy, **the 'customer journey'**, including how consumers initially become aware of options for investing in micro-generation and renewable heat and the steps they need to take to benefit from these measures, will differ for consumers in different situations. For example, we are aware that while some consumers will value packages which combine schemes and minimise the period of disruption, others are likely to prefer a more incremental approach to making their home more energy efficient[64]. It is also likely that some consumers will need to improve the energy efficiency of their home, potentially using Green Deal finance, in order to make the most of the financial benefits associated with RHI and FiTs.

A.46 DECC are aware of the need to take into account the varied needs of different customers and to ensure that there is a coherent joined-up offer across policies. Over the next few months we will be working to ensure that customers get comprehensive, good quality advice about all of the options available to them and that they understand the various actions they could take to make their homes energy efficient and the links between them. The energy efficiency customer journey must be as simple and straightforward as possible.

A.47 The roll-out of smart meters will also allow consumers to better monitor and understand their energy use. This greater understanding of energy use, will encourage the take-up of more energy efficiency and renewable technologies, allowing customers to make the most of micro renewable energy in their homes.

Combined Heat and Power (CHP)

A.48 One technology that can further contribute to a more energy efficient society at the micro and macro level is **Combined Heat and Power (CHP)**. Although macro-CHP is not an 'embryonic market' and comprises a total of 6GWe or 7% of UK electrical generation capacity, it is important to account for the further potential this form of generation has with regard to the most effective use of primary fuels, whether it be biomass or gas. CHP can deliver primary energy savings of up to 30% relative to separate generation of heat and power from the same fuel[65]. The role of CHP in reducing the carbon intensity of heat is discussed in more detail in Chapters 3 and 4 of the Government's Heat Strategy[66].



A.49 There is scope for significant growth in UK CHP capacity, from current levels of 6GWe, potentially up to 21GWe according to AEA modelling. This would be largely through further growth in industrial CHP capacity and increased deployment in the services sector. As well as improving energy efficiency, the

64 EST (2011) Trigger points –a convenient truth:promoting energy efficiency in the home. http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/Trigger-points-a-convenient-truth

65 The Scottish Government also recognises the importance of CHP and is taking forward this agenda based on a number of documents including Conserve and Save: an Energy Efficiency Action Plan for Scotland, the Scottish Government's Electricity Generation Statement and the 2020 Routemap for renewable energy in Scotland.

66 'The Future of Heating: A strategic framework for low carbon heat in the UK', http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/heat/4805-future-heating-strategic-framework.pdf

CASE STUDY 6: ExxonMobil and energy efficiency

ExxonMobil's Fawley Refinery is the UK's largest integrated oil refinery and chemical plant converting crude oil into transport fuels, lubricants and petrochemical products. The site's single largest operating expense is the fuel and electricity required to operate the refining process (approximately 60% of the site's operating expenses); the site consumes approximately 1700 MW of fuel.

The management of Fawley refinery, in common with all ExxonMobil businesses, recognise energy efficiency as a strategic goal. To this end, ExxonMobil has operated a Global Energy Management System (GEMS) since 2000 across all its refining and petrochemical operations. GEMS requires sites to identify and implement energy saving opportunities. **As a result of this, over the last decade, Fawley has improved its energy efficiency by over 20% through monitoring energy efficiency, maintaining and optimising existing process equipment and investing in equipment improvements.** These activities have ranged from no or low cost operations to large, capital intensive investments such as the use of Combined Heat and Power (CHP) facilities.

Government believes CHP capacity provides benefits in the electricity market by providing relatively lower carbon gas generation capacity, bringing new investment into electricity generation and reducing pressure on the grid and transmission losses through distributing power generation.

A.50 This Government already has a range of measures to support CHP including **Enhanced Capital Allowances**[67], which can enable a business to claim 100% tax relief on qualifying energy efficient products in the same year as the purchase is made, and preferential business rates in certain circumstances, as well as **exemption from the Climate Change Levy** (CCL)[68,69]. In addition, CHP below 2MWe capacity is exempt from Carbon Price Support[70] costs. Renewable CHP is supported through the award of **Renewable Obligation** certificates and the government is consulting on support for heat from renewable CHP via the RHI[71].

A.51 Nevertheless, development of additional gas fired CHP capacity faces high investment hurdle rates. The Government believes it worth encouraging investment in such capacity in view of the benefits set out above and funding for CHP projects is eligible for consideration by the GIB under the state aid clearance.

67 See Annex D for more detail.

68 From 1st April 2013 electricity exported from CHP to the grid will become subject to Climate Change Levy although heat from CHP and electricity consumed on-site will remain exempt.

69 See Annex D for more detail.

70 Budget 2011 announced the introduction of a Carbon Price Floor setting a clear trajectory for the cost of carbon emissions from electricity generation. This will be comprised of the ETS allowance cost plus a Carbon Price Support rate. Budget 2012 confirmed that generating capacity of less than 2MW, including CHP, will be exempt from Carbon Price Support costs.

71 http://www.decc.gov.uk/en/content/cms/consultations/rhi_exp_nondom/rhi_exp_nondom.aspx

A.52 Through the ongoing CHP Quality Assurance and Focus schemes the Government aims to provide information to promote awareness and understanding of CHP and provide information to support CHP developers[72].

Low emission transport

A.53 The Government has committed £400m to 2015 to support the early market for low emission vehicles (ULEVs). This includes funding for **the Plug-in Car Grant** (up to £5,000 for eligible cars) and **Plug-in Van Grant** (up to £8,000 for eligible vans); the £30m **Plugged-In Places** programme which is kick-starting the installation of recharging points throughout the UK; and £82m for research, development and demonstration programmes.

A.54 These initiatives are delivered though the Office for Low Emission Vehicles (OLEV), a cross-departmental unit comprising of staff and funding from the Department for Transport; Business, Innovations and Skills; and Energy and Climate Change. OLEV also has a responsibility for the EU CO_2 car and van regulations, which will make the biggest contributions to reducing CO_2 emissions from road transport up to 2020.

Further activity to support innovation and the supply chain

Driving innovation

A.55 Innovation is fundamental to improving the energy efficiency of the UK economy. For example, the rapid evolution of accessible information technology has opened up greater opportunities for individuals to control their heating use, while improvements in lighting technology provide the same service for less energy and cost.

A.56 The **Green Deal and ECO** have been designed to help drive innovation a number of ways. For example, there will be a process to enable access to increased levels of Green Deal finance if products can perform above average/default levels. In addition, DECC will be carrying out research and monitoring to improve our understanding of how measures perform in situ so that potentially over time as improvements are seen, savings estimates may be able to increase. There is also be a process for adding new measures to the list of qualifying improvements provided that there is a quantified and verified energy saving and the improvement can be modelled in the Green Deal assessment framework so that it can be 'recommended'. Smart meters will also drive innovation in the way consumers access, interpret and use their energy data and further support growth in the energy services market.

A.57 There is, however, scope to do more to support innovative ideas in this area. Evidence suggests that the process for getting new ideas officially recognised and, therefore, included in mainstream programmes such as the Green Deal, can be too slow or opaque. It is important to ensure that there is a process in place that is not a barrier to innovation and, as part of this Strategy, we are announcing that DECC will commission an **independent review of the barriers to the assessment and accreditation of energy efficiency innovations**. This will focus on the processes that Government controls, such as the Standard Assessment Procedure (SAP) and the Energy Technologies List.

A.58 In the medium term it may also be right to **consider the range of products that are available for Green Deal finance**. Any additions to the Green Deal framework would of course need to satisfy the general conditions for the scheme, including that they were fabric measures whose energy bill savings could be robustly modelled. However, the EE-MACC indicates that there is potential for businesses to make savings through investing in more energy efficient machinery. We estimate that in 2020

72 http://chpqa.decc.gov.uk/, http://chp.decc.gov.uk/cms/

CASE STUDY 7: Roll out of LED lighting – Birmingham City Council and Amey

Birmingham City Council and Amey, a leading UK infrastructure services provider, installed the first 10,000 LED lamp columns less than two years into the unique Birmingham Highways Maintenance and Management Service. The service includes a programme to replace more than 95,000 street lights, utilising state-of-the-art Light Emitting Diode (LED) technology which will cut the council's energy bill by 50 per cent, a potential annual saving of £3million, reduce carbon emissions by up to 60 per cent and improve safety. The cutting edge lights not only reduce carbon emissions but are brighter than traditional lights, and enable operators to control and adjust their levels remotely.

companies could reduced energy demand by up to 42TWh in 2020 through more efficient equipment and changes in production processes.

A.59 As the Green Deal market becomes more established, it may prove to be a useful vehicle for helping businesses to invest in more efficient machinery, both by helping them to understand what savings they could be making over a given period and by providing them with access to affordable finance. We will work with businesses and suppliers to better understand the barriers to upgrading machinery and products. And we will explore whether offering Green Deals for this type of investment would be an incentive to upgrade. Should this be the case, we will work with the pumps, motors and drives industry to consider whether these could be added to this list of measures eligible for Green Deals. We will also explore other ways of raising awareness of the return on investment on energy efficiency machinery.

A.60 DECC focuses its **innovation funding** in areas where there is a clear market failure, where the innovation makes a significant contribution to the achievement of our energy and climate policy goals and where there is evidence that the innovation need would otherwise not be supported. This year alone we have launched the following:

- *Invest in innovative refurb*: A £10m programme that will challenge stakeholders across the buildings supply chain, from owners and developers to product providers, to introduce new energy efficiency technologies and processes to support the refurbishment of non domestic buildings. The first tranche of the competition was opened in April and the second tranche in October 2012.

- *Energy Entrepreneurs' Fund:* A £35m scheme to provide funding up to £1m per project for the development and demonstration of innovative low carbon building technologies (£20m) and power generation and storage technologies (£15m). £16m has been made available to applications for the first phase from August 2012 and a second phase for applications on a rolling basis will open in January 2013. The scheme particularly aims to assist small and medium sized enterprises, including start-ups and successful applicants may be eligible for additional funding for incubation support.

- *Advanced Heat Storage Competition*: launched at the end of May and aimed at innovative thermal storage designs and demonstrators which can be integrated with heat technologies to help balance peak loads to the grid.

A.61 To ensure that **future Government energy efficiency support** has the maximum impact and has been appropriately targeted, DECC and its partners in the Low Carbon Innovation Coordination Group (LCICG) have worked together to develop a range of **Technology Innovation Needs Assessments** (TINAs). These TINAs have identified key innovation gaps, having considered the commercial potential and key economic benefits of new technologies to the UK, and **we are publishing the domestic buildings, non-domestic buildings and industrial Energy Efficiency TINAs** alongside this Strategy.

A.62 There are also other ways to drive innovation and, from next year, DECC will support **three new 'Green Business Awards'**. The analysis that underpins the Strategy has identified a need to promote and encourage energy efficiency within businesses. In particular, there is a need to engage and recognise organisations that are in the early stages of improving their energy efficiency and organisations that are using their own knowledge and experience to promote energy efficiency more widely[73]. The new awards will recognise:

- Best energy efficiency innovation by an SME;
- Biggest energy efficiency improvement; and
- Best contribution to business take-up of energy efficiency.

A.63 Energy efficiency innovation should not just focus on the way energy is used. It is also important to find innovative ways of distributing electricity that can reduce transport losses. Around 5-10% of the electricity flowing through the distribution networks is lost, and therefore incentivising their reduction is an important part of making better use of the energy we generate.

A.64 Ofgem's **£500m Low Carbon Network Fund** (LCN Fund) may be one route to doing this, alongside its focus on implementing smart grid solutions. Work undertaken by the Smart Grids Forum has identified that, up until now, there has been limited trialling of electricity demand reduction measures through this Fund due to the associated project eligibility framework. Consequently, they are currently

73 Scottish government supports an energy efficiency award in the 'Vision in Business for the Environment in Scotland' (VIBES) awards – http://www.vibes.org.uk/

Box 7: The Technology Innovation Needs Assessment (TINAs)

Buildings and industry together account for most of the UK's carbon emissions; domestic buildings 25%, non-domestic buildings 18% and industry 25%. These emissions can be significantly cut. As identified in this strategy, the largest opportunity is through deployment of relatively simple measures, many of which are cost effective.

Additional cuts in carbon emissions can be made through more innovative measures. These cuts are not as big, but are still significant, and will most likely be necessary if the UK is to meet its long-term carbon targets. Technology Innovation Needs Assessments (TINAs), commissioned by the UK's public sector innovation bodies and published to coincide with this strategy, have estimated the potential of these measures. The Carbon Trust estimate that compared to counterfactuals, where only non-innovative measures were deployed, innovative measures have the potential to make additional cuts of c.2%, 4% and 18% for domestic, non-domestic and industry respectively, cumulatively up to 2050. Realising this reduction in energy and carbon emissions would save the UK £10-70bn up to 2050. The TINAs estimate that exports of these innovative products and services would contribute £3-13bn to GDP to 2050. (Figures are low-high scenarios, mainly driven by deployment assumptions; does not include value from carbon savings.)

The TINAs identify the innovation priorities that deliver the greatest benefit to the UK. For buildings, these are not materials and components but rather methods and tools for the design, build and operation of buildings. Examples include modelling and design tools, off-site construction and industrialised retrofit techniques and smart controls. Gathering data on actual building performance is also vital. For industry, prioritises vary by industry sector and include fundamental changes to manufacturing processes, using low carbon substitutes for products and fuel, and deploying industrial Carbon Capture and Storage.

considering ways in which the criteria for LCN Fund might be revised to allow Distribution Network Operators (DNOs) to take a more active role on demand reduction and government fully supports this focus. Further, Ofgem's September 2011 RIIO consultation for Electricity Distribution networks proposes a licence condition to reduce network losses[74]

A.65 In some cases, rather than distributing gas, it can be more efficient and cheaper to distribute heat through a **heat network**[75]. For example, heat networks are an effective solution in densely populated areas with a high heat demand. They can also be used in an industrial context to supply higher temperature processes. Industrial heat networks may also provide opportunities for recovery and re-use of waste heat, cascading heat from high temperature to low temperature industrial processes and even onward for water and space heating of buildings.

74 Strategy consultation for the RIIO-ED1 electricity distribution price control, OfGem, September 2012: http://www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/riio-ed1/consultations/Documents1/RIIOED1SConOverview.pdf.

75 Chapter 3 of the Government's publication 'The Future of Heating: A strategic framework for low carbon heat in the UK', http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/heat/4805-future-heating-strategic-framework.pdf, explores this in more detail.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Annex B: Barrier: Information

Information

Definition: One of the key characteristics of the embryonic market is that there is a lack of access to trusted and appropriate information. Energy efficiency improvements are often made through purchasing upgraded equipment of which energy efficiency may only be one characteristic. Where information is available, it may be generic, and not tailored to specific circumstances, which means that potential investors are not in a position to assess the benefits of an energy efficiency investment. Financing of energy efficiency projects can be undermined by the absence of standardised monitoring and verification processes which means that the benefits of energy efficiency investments are not trusted. While information is available about overall energy consumption both in the home and in business settings, it can be difficult to relate that back to individual activities to identify opportunities to make energy efficiency improvements. In the absence of clear, trusted information, many individuals do not prioritise energy efficiency investments.

What is already happening to address this barrier?

- Nation-wide rollout of smart meters
- The Energy Saving Advice line
- Product, buildings, transport standards
- Energy Performance Certificates
- Public Sector Display Energy Certificates

What more are we doing now?: Actions include:

- A behavioural trial with the John Lewis Partnership on whether providing information on lifetime electricity running costs helps consumers;
- Beginning the process for implementing energy audits for non-SME enterprises, as required by the Energy Efficiency Directive;
- DECC being accredited under the ISO50001 Energy Management Standard
- The forthcoming DECC Evidence Strategy
- DECC support for an industry knowledge hub around refurbishment of existing homes
- Commissioning research into the potential of advanced heating controls
- Making funding available to increase the proportion of facilities managers receiving specialist energy efficiency training
- The announcement Research Council UK's new Energy Demand Research Centres

B.1 People can experience difficulties in obtaining relevant and helpful information on energy efficiency and government can have a role in providing clear, targeted, robust information, that is based on a trusted evidence base. This can include promoting regional, national and international examples of energy efficiency best practice, as represented by the case studies in this strategy. It can also mean the use of cost-effective regulation to require accurate information to be provided.

B.2 Information can mean different things to different people. It can be about telling people things they were not already aware of, or telling people facts that they already knew in a more interesting way. Some forms of information can give people a relative sense of performance, as in the case of smart meters. Finally, it can be about the messenger and whether or not they are trusted.

B.3 Findings from our recent research[76] show that people are very often not aware of how much energy they use for different activities in the home. They also do not understand how to use the technology already in their home that could help them take control of their energy use, and therefore their electricity and gas bills.

B.4 Improvements can often been seen through the provision of simple information, but the challenge is in providing this information to householders in the right way. A review of literature in this area[77] shows that many examples of initiatives designed to reduce energy usage have included information provision. Those that were most successful, tended to tailor the information so that it related directly to the individuals home or lifestyle, a key insight for future policy development.

B.5 Tailoring information to different audiences was also a key theme that we can draw from the non-domestic literature review[78]. The information available must be accessible to the target audience and relevant to the individuals using it to make decisions. For example, in the boardroom energy efficient proposals must be non-technical and given strategic value, highlighting the longer term benefits.

B.6 Companies that are big enough to employ the knowledge of designated energy and environmental managers are better placed to process and use technical information and are much more likely to have climate conscious management practices. Meanwhile, smaller firms will tend to rely more on rules of thumb and folk wisdom because they are less likely to have the time and expertise to gather and process the necessary information.

Existing activity to provide salient information

National roll out of smart meters

B.7 A commitment to mandate a roll-out of **smart electricity and gas meters** in Great Britain was included in the 'Programme for Government'.

B.8 The Government's vision is that every home and smaller business in Great Britain should have a smart electricity and, where required, smart gas meter by 2019. Energy supply companies will be responsible for the procurement and installation. Domestic customers will be offered an In-Home Display. Smart metering is a key enabling technology for managing energy systems more efficiently in the future, and providing new information and services to consumers which reduce costs and carbon emissions. Compliant smart meters are beginning to be rolled out now with mass roll out expected from late 2014. The latest Impact Assessment estimates an overall net benefit to Great Britain of around £7.2bn[79].

76 DECC, 2012, Why do comparable homes use such different amounts of energy?
77 DECC, 2012, What works in changing energy using behaviours in the home? A rapid evidence assessment
78 DECC, 2012, Evidence review of energy efficiency behaviours in the non-domestic sector: What are the factors influencing energy behaviours and decision-making in the non-domestic sector?
79 DECC, Smart meter rollout for the domestic sector (GB): Impact Assessment (Government Response Stage), April 2012 DECC, Smart meter rollout for the small and medium non-domestic sector (GB): Impact Assessment (Government response stage), April 2012

B.9 In July 2012 the Northern Ireland Government announced a roll out of electricity smart meters in homes by 2020. The options for gas smart metering in Northern Ireland will be re-examined by 2015 with a consultation on the exact nature and timescale of the smart meter roll-out in due course.

B.10 Through the Great Britain roll out, consumers will have real-time information on their energy consumption to help them control energy use, save money and reduce emissions. There will be an end to estimated billing. Switching between suppliers will be smoother and faster which will be beneficial to many customers. New products and services will be supported in a vibrant, competitive, more efficient market in energy and energy management. Suppliers will have access to accurate data for billing and to improve their customer service. They will also be able to reduce costs, for example by reducing call centre traffic, removing the need for a site visit to read meters and better manage debt.

B.11 Consumers generally have little conscious awareness of the energy they are using[80] and there is evidence[81] that consumers are keen to see better information on their energy consumption. By making energy consumption more visible, smart meters are expected to play a pivotal role in improving the way we use energy. Research has confirmed the benefits of different forms of feedback using smart meters, as trialled in the Government's Energy Demand Research Project[82] and the Carbon Trust's advanced metering trial for SMEs[83].

B.12 As the deployment of smart metering proceeds an increasing range of market-led devices is expected to become available to assist consumers to manage their energy use, including enhanced energy displays, smart appliances and home automation controllers. Smart meter systems will enable a secure and consumer friendly way of connecting these devices into their smart meters.

B.13 More broadly, better data from smart metering will support other energy efficiency policies, for example by reinforcing Green Deal assessments. Energy networks will also have better information upon which to manage and plan current activities and move towards smart grids which support sustainable energy supply. Smart meters are a critical part of the platform for the development of smart grid and demand-side measures. Smart meters will support more efficient use of electricity infrastructure by providing better information and improving communication between consumers, electricity suppliers and network companies. Network operators will for example, be able to improve electricity outage management and resolve any network failures more efficiently once a critical mass of smart meters has been rolled out; and they will be able to realise further savings from more targeted and informed investment decisions. By enabling time of use tariffs, which tend to shift a proportion of electricity generation to cheaper off-peak times, smart meters are also expected to generate savings both in terms of distribution as well as generation capacity investment.

Supporting consumers

B.14 As described in Annex A, in April 2012 this Government launched the **Energy Saving Advice Line**[84]. As well as giving out general advice on energy efficiency and the Green Deal, it is providing information about existing Government schemes like CERT and Warm

80 DECC, 2012, Why do comparable homes use such different amounts of energy?

81 For example, a Future Foundation 2006 survey for Logica showed that 70% of GB consumers want better or more frequent information – Future Foundation (2006) Energy Efficiency – Public Attitude, Private Action.

82 AECOM for Ofgem (2010): Energy Research Demand Project: Final Analysis. (http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=21&refer=Sustainability/EDRP).

83 http://www.carbontrust.com/media/77244/ctc713_advanced_metering_for_smes.pdf

84 The Energy Saving Advice Line number is 0300 123 1234. Energy Saving Scotland advice centre network on 0800 512 012.

Front and directs through to the Welsh Government's Nest programme.

B.15 In future, DECC will be developing its approach to communications in line with the UK Government Digital Strategy. This will mean focusing on 'digital by default', and creating effective ways in which to provide services through digital channels, including information on energy efficiency and the options that are available to domestic and business consumers.

B.16 Further to the actions of DECC, the Local Government Association launched **Climate Local** in June 2012. This initiative is designed to drive, inspire and support council action on climate change. It focuses on councils' efforts both to reduce carbon emissions and to improve their resilience to the anticipated changes in the climate.

Product standards

B.17 Energy using appliances and products are responsible for a large proportion of total energy use in the UK. Consequently, product standards have had a notable impact in recent years, with current policy is centred around two pieces of European Legislation. Regulations made under the **EU Ecodesign Directive**[85] set minimum standards that remove the least efficient products from the market, and those made under the **EU Energy Labelling Framework Directive**[86] rank products ('A to G labels') in terms of their relative energy efficiency. Measures already introduced under EU products regulation, and those currently under discussion, are projected to save 36 TWh of energy in 2020, relative to business as usual. This accounts for 22 per cent of total energy savings from the current policy package in 2020.

B.18 Products are used across all sectors, but Defra, DECC and the Energy Saving Trust recently conducted a detailed study of domestic electricity use[87]. The findings are summarised in box 8 below and will feed into future strategic and policy considerations in this area.

Transport standards

B.19 The transport sector equates to 38% of energy use in the UK[88] and the below chart shows how this breaks down by mode of transport. Efficiency in this sector can be increased through improved logistics, better driving behaviours and techniques and, most significantly, through continued improvements in vehicle fuel efficiency. The efficiency of new cars in the UK improved by over 29% between 2001 and 2011, allowing new car owners in 2011 to drive on average an additional 12 miles per gallon compared with new car owners in 2001[89].

B.20 Such returns are becoming more and more important to the motorist as fuel prices continue to increase, so presenting opportunities to industry in this highly competitive and skilled sector. The direct link between CO_2 emissions and conventional vehicles fuel efficiency means that as manufacturers are forced to meet the tough EU legislation[90] targets set for 2015 and 2020 for cars, 2017 and 2020 for vans, users will benefit from even higher fuel economies. A recent

85 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0125:EN:NOT,

86 Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0030:EN:NOT,

87 Powering the Nation: Household electricity-using habits revealed: http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/Powering-the-nation-household-electricity-using-habits-revealed

88 For 2011: http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-consumption/2325-factsheet-transport-energy-consumption.pdf

89 The Society of Motor Manufacturers and Traders Ltd.

90 Regulation (EC) No 443/2009 [cars] and Regulation (EU) No 510/2011.

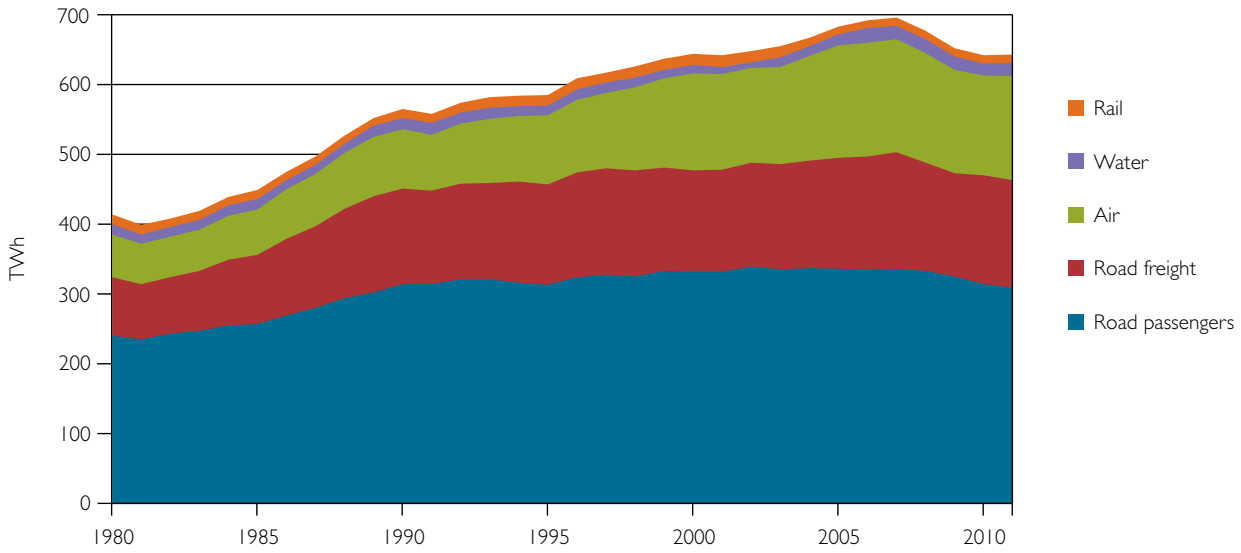
Box 8: The Household Electricity Study

In 2010, Defra, DECC and the Energy Saving Trust jointly commissioned an ambitious, ground-breaking study designed to uncover the actual, day-to-day, minute-by-minute, electricity consumption habits of the nation.

The findings were published in June 2012 and included insights such as:

- Domestic background standby consumption was much higher than previously estimated. On average, the study households spent between £50 and £86 a year on their appliances in a standby, or 'non-active', state.
- Between 14-20% of household bills could be saved if households changed to the most efficient appliances.
- Consumer electronics and information technology, excluding electricity for water heating, accounted for 26% of household electricity demand in houses.
- The monitored one-person households used as much, and sometimes more, energy as typical families on particular appliances. In particular, for cooking and laundry it was observed that the power demand of lone dwellers matching or exceeding those of average family units.
- We consume much more energy on keeping our crockery, glasses and cutlery clean than we do on our clothes. Households with dishwashers used on average nearly double the amount of electricity on this appliance than they did on washing machines.

Figure 12: UK transport final energy consumption, by mode of transport: 1980-2011[91]



91 Energy Efficiency Statistical Summary http://www.decc.gov.uk/eedo

CASE STUDY 8: Toyota – Energy Conservation Programmes

Toyota recognises that effective energy conservation requires measures that go beyond simply manufacturing and selling fuel-efficient vehicles. Its focus is to reduce energy usage at every stage of a vehicle's lifecycle, from its initial design right through to its ultimate disposal and recycling. In the UK, Toyota has implemented a robust and effective suite of energy conservation programmes.

In terms of industrial operations, Toyota Manufacturing UK (TMUK), **has reduced the amount of energy used for every car made at its factory in Burnaston, Derbyshire, by 65% since production started in 1992.** TMUK has installed one of the country's largest solar arrays on an industrial site, a commitment to renewable energy that is fundamental its 'sustainable plant' strategy' and builds on 20 years of continuous improvements in environmental performance. Encouraged by the UK Government's Feed in Tariff policy. The array has been operational for more than a year and the electricity it generates from renewable (solar) sources is equivalent to that needed to build 7,000 cars a year.

In its retail business, Toyota (GB) PLC and its 180-strong retail network have embarked on a challenge to reduce their carbon footprint by 20% in three years. With the help of advice from the Carbon Trust, the measures it is implementing are prioritised according to their potential results in cutting carbon emissions. **The first 12 months of the programme have seen a reduction of more than 5,000 tonnes of CO_2, with added benefit of a financial saving in the region of £750,000.**

European Commission Impact Assessment reported that an average motorist could save around £500 per year by 2020 through improvements in vehicle fuel efficiency.

Building standards

B.21 Part L of the Building Regulations in England (and its equivalent within the Devolved Administrations) sets minimum energy efficiency standards for new buildings and for 'building work' to existing properties, including extensions and conversions. Part L standards have been regularly updated and improved by over 70% since 1990. In 2006, changes to Part L for new buildings were made in line with the European Energy Performance of Buildings Directive (EPBD) to set overall performance standards in the form of a CO_2 target. In 2010[92] changes required a 25% improvement relative to the 2006 standards and earlier this year a Government consultation looked at opportunities for further improvement from 2013 mindful of the Government's growth agenda and commitments to reduce regulatory burden overall[93,94]. We continue to consider the responses to the Building Regulations consultation carefully and will announce the way forward in due course.

92 2012 in Northern Ireland.

93 Building regulations are devolved to Scotland. The changes to the new-build energy standards in 2010 deliver a 30% reduction in CO_2 emissions when compared to the previous standards. Public consultation on the next set of standards is expected before the end of 2012. Further improvements are planned for Wales in 2014 and 2015 following the transfer of Building Regulations functions to Welsh ministers in 2012..

94 2014 in Northern Ireland.

B.22 As an extension of this building policy, Government has a long-term trajectory to **decarbonise new buildings in England** through its policy for zero carbon new homes and non-domestic buildings, with energy efficiency standards forming a key part of the approach to carbon savings. Government is working with industry and other partners to develop and implement a flexible and cost-effective framework to enable this. In Wales, building on the significant improvements proposed for 2014/15 a further review of standards is proposed for 2016 with a view to ensuring the requirements for nearly zero energy buildings under the recast Energy Performance in Buildings directive by 2018 for the public sector and 2020 for all new buildings.

B.23 **PAS 2030** is a new installer standard for the Green Deal and was published in February 2012. It was developed on our behalf by BSI in co-operation with industry representatives to ensure consistent, robust, and high quality standards for the installation of all measures funded through the Green Deal. Throughout the process our intention has been to ensure that we do not unnecessarily add additional burdens on businesses – especially SMEs – who work under other government funded schemes (DECC's Microgeneration Certification Scheme and DCLG's Competent Person Self-Certification Scheme).

B.24 PAS 2030 is currently being updated to include new measures and ensure consistency with DECC's Microgeneration Certification Scheme. The new version will be published in late November/early December 2012 and will be reviewed on a regular basis to ensure it is fit for purpose.

Energy Performance of Buildings Directive (EPBD)

B.25 Introduced as part of implementing the **EU Energy Performance of Buildings Directive 2002**, **Energy Performance Certificates** (EPCs) present energy efficiency ratings of both domestic and non-domestic buildings on a scale from A to G based on an assessment of the age, size and fabric of the building. The EPBD was implemented into law via the Energy Performance of Buildings Regulations 2007[95] and the Regulation 17(e) of the Building Regulations 2000 (since superseded by the Building Regulations 2010)[96]. The most efficient buildings are in band A. The certificate for dwellings also uses the same scale to define the impact of a home on the environment, using CO_2 emissions as its measure. For both ratings, average dwellings in the UK span bands D and E.

CASE STUDY 9: Greenhill Primary School

Greenhill Primary School in Gelligaer, Wales was the first school in the UK to achieve an Energy Performance Rating of A+. They used on site electricity generation such as photovoltaic panels, wind turbines and a micro combined heat and power unit. The utilization of wind energy generated 1,060kWhrs of electricity per annum from the four micro turbines. **As a result they saved £24,000 over a period of 12 months from opening in June 2011.**

95 2008 in Northern Ireland.
96 Part F of the Northern Ireland Building Regulations.

B.26 As well as providing the above performance information the EPC, which must be made available when a building is sold, rented out or constructed, **contain recommendations on a range of measures to improve the building's energy efficiency**. Measures such as installing more insulation tend to be cost effective because of the short payback periods associated with them.

B.27 Unlike the EPCs, **Display Energy Certificates** (DECs), which have been implemented following the **Energy Performance of Buildings Directive 2007**[97] for public sector buildings with over 1000m^2 of usable floor space (500m^2 from January 2013), show actual energy use and not just the theoretical energy rating of a building. Using the same A to G scale, the DEC takes into account the fabric of the building, the lighting and heating and ventilation plant in it, and the way in which this infrastructure is used[98].

B.28 A recast of the Directive will be implemented on 9 January 2013. The Recast will introduce the following requirements:

- minimum energy performance requirements to be set for all new and refurbished buildings and compared against requirements

CASE STUDY 10: Skanska intelligent building solutions

Skanska is carrying out an energy usage and carbon reduction exercise at its headquarters in Maple Cross, Hertfordshire. Maple Cross House is a 9,000m^2 office space built in 2001. Skanska has the lease on the whole of the building until 2023.

By modelling the existing performance of the building, in terms of energy consumed and the subsequent carbon emissions, utility costs and projected Carbon Reduction Commitment (CRC) payments, Skanska was able to identify an optimum selection of energy conservation measures whose costs will be paid back before the expiration of the lease.

The landlord's asset manager (Henderson) and the landlord's agent (Cushman & Wakefield) have fully embraced the works, and Skanska has signed off the initial investment of over **£1.5 million**.

Guaranteed savings are derived from utility savings, feed-in tariffs, renewable heat incentives, the CRC Energy Efficiency Scheme and enhanced capital allowances.

The project will reduce the building's energy consumption by up to 30 per cent; reduce the building's carbon emissions by up to 39 per cent and reduce energy bills by up to 47 per cent over ten years.

97 Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007.

98 Implementation of EPBD is devolved to Scotland. EPCs are used for Public buildings to enable comparison across the building stock. The option to record operational energy use on a year on year basis will be through Section 63 of the Climate Change (Scotland) Act 2009.

calculated in accordance with cost-optimal requirements;

- energy use of technical building systems to be optimised by setting requirements relating to installation, size, etc;
- all new buildings developed after 2020 to be nearly zero energy buildings, with an earlier target date of 2018 where the building will be owned and occupied by a public authority;
- property advertisements to include details of EPC rating where available;
- DECs to be issued and displayed in buildings larger than 500m² that are occupied by a public authority and frequently visited by the public. This threshold will fall to 250m² after 5 years;
- EPC to be displayed in commercial premises larger than 500m² that are frequently visited by the public, and where one has previously been issued.

Further activity to provide salient information

Achieving expected levels of energy performance

B.29 It is important that designed levels of energy performance are achieved in practice. There is evidence that this is not happening. The reasons for this are complex, touching on a whole raft of issues concerning the way that buildings are designed, built and operated. There has been a particular focus on the challenge for new homes, but it is equally relevant for non-domestic buildings, as well as retrofit. The consultation on the Building Regulations earlier this year discussed how these issues might be tackled for new buildings and the house building industry has itself made proposals for a programme of work. The Green Construction Board is also looking at the issues, particularly focusing on non-domestic buildings.

Further products potential

B.30 Product standards have delivered significant improvements in energy efficiency over the years. For example, in 2011 46% of domestic appliances with an EU energy label were rated A or above, compared to only 21% in 2006. However, there is room to deliver more. Even after minimum standards have been introduced there remains a big difference between the most efficient and least efficient products.

B.31 To change the standards themselves will require further medium-term negotiation at a European level. **Defra will continue to press for ambitious, but cost effective, standards for products** covered by the Ecodesgin and energy labelling Directives. We must learn what is possible from the wider international examples that are available.

B.32 We should consider opportunities relating to the information that is available to a customer at the point of sale of a product. Although there

CASE STUDY 11: Japan – Top runner programme

The Top Runner Programme was introduced in April 1999 to drive innovation by delivering energy efficiency products into the market and reduce energy consumption in the household, commercial and transport sectors. The scheme set mandatory energy efficiency standards based on the most energy efficient products in the market at the time. It obliged manufacturers to develop products which exceed the standards, typically in 4-8 years time. There are currently 23 products covered under the scheme, including cars, air conditioners, TVs, fluorescent lights, and refrigerators. **It has increased energy efficiency of air conditioners by 67.8% (from 1997 to 2004) and refrigerators by 55.2% (from 1998 to 2004).**

are existing European labelling requirements on energy use, these are reported in kWh per year, rather than in estimated monetary terms for the life of the product. Indeed, consumers in many purchasing situations focus on the initial cost as opposed to the **lifetime running costs**. In exploring the idea that better information would mean better consumer decisions, a recent Norwegian field experiment demonstrated that providing information about lifetime electricity running costs at the point of sale led to the purchasing of more energy efficient models of tumble dryers[99].

B.33 **DECC is now working with John Lewis Partnership to replicate a similar behavioural trial in the UK.** This trial will give further evidence as to whether providing information on lifetime electricity running costs does help consumers choose more energy-efficient household appliances. The trial will run during 2013, with findings feeding into future policy making.

Sustainable public procurement

B.34 There is also **scope for central Government and the wider public sector to use its purchasing power** to drive up standards in relation to products and services that it procures, as well as to take the lead in encouraging others to do the same. The public sector as a whole has approximately 16% of the UK's purchasing power, and central government including agencies have about 10% of our purchasing power.

B.35 Using the public sector's spending power to purchase the most efficient products will pull through the manufacture and innovation of products that provide whole life value for money and also reduce the public sector's carbon footprint. In this way, government can support and drive forward high product standards, encouraging others to do the same. The London Olympics earlier this year provided examples of how good sustainable procurement saves money and delivers carbon savings.

B.36 Government Buying Standards (GBS) have been developed by Defra over several years to seek to ensure the purchase of highly efficient products. They set minimum standards for central government for immediate procurement as well as higher standards that are expected to come into place in the future. A key element of these standards is energy efficiency. These standards are mandatory for central government departments and their agencies under the Greening Government Commitments, entered into in February 2012 as part of the commitment to be the Greenest Government Ever. We are exploring the scope for potential to developing these tools further to take on board the potential to drive forward innovation and the Aldersgate Group will be presenting recommendations in this respect in the near future.

B.37 At the same time, government is seeking to drive innovation in products through using different forms of forward commitment procurement. BIS are currently working with the Prince of Wales Corporate Leaders Group on three procurement compacts, zero carbon catering, low emission vehicles and energy from biomethane. This involves government departments and industry making a clear commitment to buy these highly innovative products once developed and to work with business to seek to develop them. In addition, Defra is exploring new business models such as leasing arrangements which create the right incentives for reduced environmental impact, and is seeking to bring together good examples of energy service contracts that also set the right incentives.

B.38 Government is also promoting, through the Greening Government Commitments, good supply chain management through seeking reports on supply chain emissions. A tool is being made available to authorities to assist them in obtaining reports from suppliers on these impacts. The intention behind this is to drive energy efficiency across the supply chain, encouraging innovative action that makes

99 http://www.greenudge.no/en/studier/artikkel-under-studier/

industry more energy efficient and therefore more competitive as well as resilient in the face of energy price fluctuations.

B.39 Defra and DECC will work together, and with Cabinet Office, to ensure that our tools for sustainable public procurement and their use are as effective as possible in **driving energy efficiency in central government and its agencies**, as well as the wider public sector.

Further transport standards potential

B.40 Further **electrification of the rail network** will bring energy efficiency benefits as well as reducing rail journey times, operating costs and dependency on fossil fuels, particularly as low carbon electricity generation increases. The government is committed to electrification of Midland Mainline, various lines in the North West of England, the Great Western Main Line and the Welsh Valleys.

B.41 Further investment in electrification was announced in July 2012 as part of the High Level Output Specification (HLOS) that set out the intention to create an 'Electric Spine' for passengers and freight stretching from Southampton, the Midlands and Yorkshire. The HLOS also required the industry to establish energy and carbon efficiency performance indicators as part of their plans. Later this year, the rail industry will publish the 2012 version of the Rail Technical Strategy. This will set out longer term strategies to improve rail's energy and carbon performance through the development and application of novel technology.

B.42 **Road freight** is another area of energy efficiency improvement potential and the freight and logistics industry is putting in place a wide range of measures which improve efficiency and reduce fuel use, through a mixture of operational and behavioural measures, as well as new equipment and technology. These include improved use of vehicle capacity, improved routeing and scheduling, driver training and performance monitoring through telematics, improved engine efficiency and vehicle aerodynamics.

B.43 In addition, the Department for Transport has initiated a number of trials to explore the real, practical benefits of energy efficiency measures for road freight. In 2012 they started a two year trial of low carbon trucks whose CO_2 emissions were at least 15% lower than those emitted by equivalent diesel vehicles, to demonstrate that new fuels are feasible and practical. A separate ten year trial, also

CASE STUDY 12: John Lewis Partnership – Reducing road miles

With a fleet of around 2,500 vehicles, a key priority for John Lewis Partnership is the reduction of emissions from transport operations. The Partnership has considered ways to reduce both road miles and the number of trucks on the road, using optimised scheduling, backhauling and improved load efficiency. A 10% increase in load efficiency has led to a 10% reduction in road miles. John Lewis were among the first in Europe to use double-deck trailers and now operate nearly 200. Broadly, 2 double deck vehicles replace 3 conventional vehicles. **Although each double deck vehicle uses more fuel than a single deck vehicle, the fuel saving through the reduced number of trucks on the road is over 20%.**

commenced in 2012, is considering the impact of using longer semi trailers. Should the trial prove successful, there are potentially substantial energy efficiency benefits as the increased capacity from these trailers should lead to a reduction in lorry miles.

Energy audits for larger businesses

B.44 Article 8 of the EU Energy Efficiency Directive 2012 requires larger businesses (non-SMEs with above 250 employees) to have **an energy audit every four years**. As explained in the strategy above, EEDO will lead on co-ordinating the implementation of the Directive, which must be completed for most parts within 18 months of the Directive coming into force. We will **launch a consultation on implementing Article 8 in the first half of 2013.**

B.45 The Directive defines an energy audit as a 'detailed review of the energy consumption profile of buildings or groups of buildings, industrial operations or installations, including transportation.' The options for implementing for this will be considered within the context of ensuring compliance with the Directive, minimising the administrative burdens on business while ensuring coherence with existing audit-type requirements. We will need to consider such issues as the scope of audit, whether it is undertaken in-house or through an external provider and the role of ISO 50001 as an alternative to an audit. We will also consider whether we might build on the existing DEC (Display Energy Certificate) process that applies to public authority buildings, and how we might encourage the take-up of findings of an audit[100].

B.46 Given the importance of this policy issue, it will be necessary to evaluate its impact, both in terms of associated administration burden and how well it incentivises greater energy efficiency. To ensure the effectiveness of implementation, we will evaluate this policy, consider whether a review is required, what to review and the format of doing it within two years of implementation.

Energy management standards

B.47 There are other ways in which businesses can help themselves. For example, by using a best practice document, such as the **ISO50001 energy management standard** that was published by the International Organisation for Standardization (ISO) in June 2011[101]. ISO 50001 can be used as a stand-alone document or to complement other standards, such as ISO14001 (environmental management) and can provide public and private sector organizations with management strategies to deliver increased energy efficiency, reduced costs and improved energy performance.

B.48 Such voluntary energy management standards will not, however, deliver all the solutions on their own. Research has shown that as well as identifying low or no cost measures to improve efficiencies, investment may be needed to make long-term improvements. A standard such as ISO 50001 can ensure that the focus of an organisation is on better energy management and certification will provide reputational benefits too.

B.49 ISO50001 can be applicable to commercial, industrial and public sectors. For example, Sheffield Hallam University, which has made savings to the value of £10,000 a month since implementing ISO50001. **DECC has begun its own assessment of its estate and operations against this standard** with a view to applying for certification during the course of 2013.

B.50 Another standard that can help organisations manage their energy use is **EN 16247-1 Energy audits**, created by the European Committee for Standardisation (CEN) published in July 2012. An energy audit helps an organisation identify energy use and

100 Scotland will consider the use of reporting operational energy use for buildings on a year on year basis as a part of the wider energy audits required by the Directive.

101 ISO50001 Energy Management Standard, International Organization for Standardization (ISO), June 2011.

CASE STUDY 13: Bentley Motors

Bentley Motors' headquarters in Crewe has been the first plant in the UK automotive industry, and one of the first companies anywhere, to achieve the new energy management standard, ISO 50001. As part of this a series of initiatives were undertaken, including improved heating and lighting, better controlled boiler and compressed air systems, greater insulation and more efficient variable speed drives. The results of this and past work have been significant. **Between 2000 and 2010 the energy used on site for each car produced was reduced by two thirds, and by 14% for the overall site.**

this information can be used to reduce energy consumption, increase efficiency and save money. EN 16247-1 can be used as a first step to create a plan for good energy management.

Developing a stronger evidence base

B.51 The quality of the information that is available is critical to how well we are able to improve the energy efficiency of the UK in the coming decades. The information has to be clear and has to be trusted by those who will be making the investment or deciding to change their behaviour.

B.52 One priority area is ensuring a properly co-ordinated research framework for energy efficiency. Funding is rapidly expanding in this area and there is a challenge for all involved, including government, the research councils, industry, NGOs and international bodies, to avoid ineffective use these resources and duplication of effort.

B.53 DECC will be further considering its medium and longer term energy efficiency evidence needs, and developing plans to obtain this information, through specific research and larger thematic research areas to be agreed with third parties. We will set out the priority areas in a **DECC Evidence Strategy** which will be published next year.

B.54 Government will play a proactive role in ensuring better co-ordination by supporting and participating in the Research Councils UK development of **a Research Roadmap**, which will include energy efficiency alongside other priorities in the energy sector. This work will be led through the Research Councils UK (RCUK)

Box 9: the National Energy Efficiency Data-framework (NEED)

In 2011, DECC published the first results from the National Energy Efficiency Data-framework (NEED). This framework is a key tool for energy efficiency analysis and evaluation, matching data on energy consumption with property, household and business information together with records of energy efficiency measures installed. This analysis enables a deeper understanding of how energy is used in buildings and has demonstrated that the installation of energy efficiency measures enables significant energy savings for real households. Work is currently underway to analyse energy use in the non-domestic sector. The latest NEED analysis was published by DECC on 5 November 2012.

Box 10: End Use Energy Demand Research Centres

In order to meet the 2050 carbon targets the UK will, in addition to decarbonising the energy supply, have to significantly reduce its energy consumption. Currently we lack deep understanding of the complexities of what really drives energy demand and how to change it at user and provider levels. If these complexities are to be understood, energy demand research must adopt inter-disciplinary, multi-agency approaches to deliver understandings of:

- the lifestyle and social drivers of the demand for energy services;
- changing technologies and how they are adopted at the point of use;
- the institutional and policies frameworks within which technical and social decisions are made; and
- the interactions between all of these.

The mechanism chosen to support research in this area is the formation of interdisciplinary research centres. The centres will be expected to take particular, strategic measures to ensure that the full potential impact of their whole programme of activity is realised. Individual centres will be brought together by a high level networking facility to aid public engagement, interaction with users and promote any synergies between research projects.

The centres are being jointly funded by the Research Councils UK Energy Programme, the Economic and Social Research Council (ESRC) and the Engineering and Physical Sciences Research Council's (EPSRC) Manufacturing for the Future Programme. Five centres have been supported and they will run for five years. £26 million has been made available for funding of the centres by the Research Councils and an additional £13 million is being contributed by project partners.

The centres are:

Director	Lead institution	Other institutions	Title	Funding
Elizabeth Shove	Lancaster	Aberdeen, Leeds, Birmingham, Reading Manchester, UCL, Sheffield, Sussex	Dynamics of energy, mobility and demand	£3.9m
Julian Allwood	Cambridge	Bath, Leeds, Nottingham Trent	A National Research Centre for reducing industrial energy and material use in supplying UK needs	£6.2m
Sawas Tassou	Brunel	Birmingham, Manchester	Centre for sustainable energy use in food chains	£6.0m
Steven Sorrell	Sussex	Oxford	Research centre on innovation and energy demand	£3.7m
Tadj Oreszcyn	UCL	N/A	RCUL centre for energy epidemiology (CEE): the study of energy demand in a population	£5.9m

Energy Programme Strategy Fellowship, which was established in April 2012 for a period of five years. The main goal of this Fellowship team for the next 18 months is to produce a 'prospectus' of energy research, skills and training needs.

B.55 This will build on the large Energy Efficiency Programme that RCUK has run over recent years. From 2008-2011, the programme funded strategic research in three sectors: buildings (£40 million[102]), transport (£15.85m) and industry (£5.7m) – including various projects focused on energy efficiency.

B.56 Since 2011 there has been a growing recognition of the importance of understanding the entire energy system when considering energy demand, including emerging technologies and the way people behave when they use them. This has culminated in a decision to fund up to six, multidisciplinary **End Use Energy Demand (EUED) Research Centres** to a value of £26 million. These will run for five years and improve our understanding of how energy efficiency measures can reduce demand for energy services.

B.57 RCUK have now decided on the winning proposals for this programme and, given their importance to our energy efficiency mission, they are being announced alongside this strategy (see box 10).

B.58 The Technology Strategy Board (TSB) is a non-departmental public body set up by government to stimulate technology-enabled innovation in areas that will boost UK growth and productivity. The TSB is creating a network of **seven Catapult Centres** to transform the UK's capability for innovation, delivering against both the 'embryonic markets' and 'information' barriers that we have identified. The aim is to contribute to economic growth by creating critical mass for innovation, including around energy efficiency.

Developing the evidence base for the industrial sector

B.59 There may be a case for carrying out further research to improve the evidence base on industrial energy efficiency potential. A key purpose in looking at this is to ensure appropriate targeting of future policies, especially for medium energy intensive sectors. In particular this research could include a detailed assessment of overlaps and gaps in the coverage of current policies. This would include policies that encourage more efficient use of gas, electricity and other fuels and potentially heat. Research could also be carried out to build on the analysis on the potential for reductions in electricity demand undertaken with McKinsey & Co[103]. The Department is also taking forward work in this area through the Heat Strategy.

B.60 A significant amount of information has been published by a range of bodies providing estimates of the amount of additional potential for energy efficiency in industry. Some estimates take account of scope for adoption of existing technology, others take account of technologies that need to be tested or demonstrated, and others take account of potential for innovation and development of new technology (requiring research and development). Reports also focus on potential in different sectors or cross-sections of the industrial or manufacturing base.

102 This includes £11m co-funded with the RCUK Digital Economy program.
103 DECC, Capturing the full electricity efficiency potential of the UK, July 2012: http://www.decc.gov.uk/en/content/cms/emissions/edr/edr.aspx

Box 11: The Energy Technology Institute

The Energy Technology Institute (ETI) is a public-private partnership between global industries – BP, Caterpillar, EDF, E.ON, Rolls-Royce and Shell – and the UK Government. It accelerates the development of secure, sustainable, low carbon technologies. It does this by targeting investments to bridge the gap between laboratory research and commercial deployment.

The £100m, 5 year **Smart Systems and Heat Programme** is the single largest in the ETI portfolio. It is focused on reducing and managing demand through leading edge energy efficiency technologies. The programme begins with a 2 year, £3m bespoke social research project to build technology development and deployment upon a sound understanding of why people use heat energy in the ways they do. It has already attracted additional global investments from Hitachi via their UK base in Maidenhead.

The Smart Systems and Heat Programme will improve our understanding of what low carbon energy efficiency technologies can deliver in real situations. DECC is working with the ETI to ensure this investment delivers robust evidence which informs energy efficiency policies.

B.61 The Carbon Trust for example has published on its website its assessment of the total percentage carbon and energy cost savings identified in a range of organisations, including the chemicals sector. In this sector, it identified potential savings of 7%. In 2008 the Carbon Trust set up the Industrial Energy Efficiency Accelerator to identify innovation opportunities for carbon reduction in mid-energy intense industrial sectors. Within this programme it published information identifying potential solutions to improve energy efficiency in fourteen sectors.

B.62 A number of trade associations, are also active in providing information on energy efficiency opportunities, including energy efficiency audits to identify opportunities on a site-specific basis. For example, the British Pump Manufacturers Association (BPMA) provides energy audits through its Certified Pump System Auditor Scheme.

B.63 While information is currently available on scope and opportunities for improving industrial energy efficiency from a range of published sources, it is not clear whether, or the extent to which, this information is fully utilised. There may therefore be a role for facilitation of information flow, and raising of the profile of energy efficiency opportunities. This is an area where we will consider whether additional research could be undertaken to understand in detail how uptake of energy efficiency opportunities in mid-energy intense industrial sectors could be further encouraged.

Developing a trusted source of information for installers

B.64 The energy efficiency information barrier concerns not only the specific potential of particular technologies, singly or in combination, but also how they should best be installed and the related costs and benefits. There is also the issue of trusting the source of the information and evidence.

B.65 There are already a number of different providers of energy efficiency hubs providing information on energy efficiency including the research and voluntary sectors. These include the Zero Carbon Hub, National Refurbishment Centre and Energy Efficiency Partnership for Buildings. These are targeted to different user groups including households and businesses but there is not yet a comprehensive and fully trusted source of information for the construction industry specifically around refurbishment.

B.66 To address this gap, Government is working in partnership with the construction industry in the development of **a knowledge hub for existing homes, or buildings more broadly**. The Green Construction Board have commissioned a scoping study to determine what is needed by the industry and Government to overcome this barrier with a view to developing an evidence and advice hub or other support mechanism next year.

Consumer engagement in smart metering

B.67 As part of the GB Smart Meters Programme, the Government has developed **proposals for a coordinated Consumer Engagement Strategy**, in order to ensure that we maximise the energy efficiency and other benefits as well as achieve a successful roll-out. Although suppliers will have the primary consumer engagement role as the main interface with the consumer, the plans for supplier engagement to be supported by a programme of centralised engagement undertaken by a Central Delivery Body (CDB).

B.68 Third parties such as charities, consumer groups, community organisations, local authorities, housing associations and friends and family will also have an important role as 'trusted messengers'. This may be particularly true for some vulnerable consumers.

B.69 Given the important role these third parties could play in engaging consumers, it is important to have a mechanism to coordinate this engagement. The Centralising of some engagement activities under one delivery mechanism would assist and allow for the possibility of an umbrella brand to position individual suppliers' roll-outs as part of a national programme. The Government has consulted on proposals for requiring energy suppliers to develop a central delivery body for smart metering consumer engagement, and will be publishing final conclusions shortly.

The potential of smart controls

B.70 In achieving greater energy efficiency, it is not only about the quality of information, but it is important how it is applied. As the evidence base improves we will ensure that it is disseminated in a way that enables those who sell and install energy efficiency measures to provide up to date and trusted advice to the consumer. In this vein, the UK also needs to harness the potential of the quickly evolving IT sector. Smart controls can allow people to actively influence their energy use and so energy bills. The smart meter roll out opens the door to a range of better information on which smart controls and innovative services can build.

B.71 A recent literature review[104], however, found that the market is currently failing to deliver effective heating controls. It reported that consumers find heating controls difficult to use and many do not use them effectively. It highlighted that the elderly and those in local authority housing were more likely to find their controls too complex and that tenants were less likely than owner-occupiers to have a full set of controls (thermostat, timer and thermostatic radiator valves (TRVs)). There are various ways that emerging technologies could improve heating control systems. Some focus on making it easier for occupants to control their heating systems. Others automate heating, for instance by learning how long it takes to heat buildings, when they are occupied and what temperatures occupants prefer.

B.72 We must learn quickly to make the most of this opportunity. Consumption of energy in domestic buildings accounts for 28% of final energy use, with 60% used for space heating. Advances in heating control technologies may have the potential to save some of this energy, but there is currently no robust evidence on how such heating controls impact heating demand. It is possible that energy savings may fail to materialise, for instance because

104 Consumer Focus (2012) Consumer and domestic heating controls: a literature review.

technologies do not operate as expected or are unpopular with occupants.

B.73 To address this evidence gap, **DECC is announcing an innovation program to assess the potential of advanced heating controls to reduce domestic energy demand**. If, for example, this showed that advanced heating controls saved energy, there might be implications for policy, whether it be by becoming eligible for Green Deal finance or integrated into future changes to Building Regulations.

Education

B.74 The potential of increased energy efficiency is relevant to all of us and, as the evidence improves and as new technologies for heating and better energy use are introduced into the home, it is important that the next generation understand what they mean for them and the benefits that they can bring. With this in mind, EEDO will work with the Department for Education to identify **suitable curriculum opportunities for teachers to discuss energy use** during science lessons

Training and skills

B.75 Those energy professionals who are at the front line need the right information to make the right decisions and influence others. For example, in larger premises it is the facilities manager who should have an understanding of the buildings energy use. For improvements to be made it is paramount that they are aware of the energy efficiency potential within the

CASE STUDY 14: Ashley C of E Primary School

Ashley C of E Primary School is a two-form entry primary school of 400 children in Walton on Thames, Surrey. For five years the school has put energy efficiency at the heart of its daily practices with a team of children, year on year, leading the project and ensuring energy efficiency is a consistently high profile feature of the school.

Through a combination of weekly measuring and monitoring of energy use, the setting of targets for different blocks around the school, a programme of energy efficiency installations, and the rewarding of success when the block specific targets have been met, **the school has reduced its consumption by over 50% during this time, so saving an average of £5,000 per year on energy bills.**

Just as importantly, the practices have extended out into the school community, where families have been set energy efficiency challenges around electricity use; something that all the family can address. With the challenges in place, families have then been asked to share back their weekly electricity scores and they are rewarded when they reduce their consumption and meet specific targets. Last year close to 100 families out of just over 250 participated in the project.

As a result of this work on energy efficiency there has been a fundamental shift in practice both in the school and out in the wider school community. Energy efficiency is now part of the school's culture.

building they are responsible for and have the right levers to take action. Importantly, the energy performance of UK non-domestic buildings has failed to improve at a rate commensurate with the acknowledged potential for these cost effective savings.

B.76 To develop the energy management skills of **facilities managers** DECC will be working with Asset Skills, the employer-led skills body for facilities management to ensure that energy efficiency is integrated into the core modules of the National Occupational Standards for facilities managers (FM). DECC is also planning to make available funding for the purpose of promoting and incentivising the take-up of more specialised energy efficiency training among facilities managers and production line managers; training providers will be able to apply to DECC for funding which could be used to subsidise the costs of existing training modules or to otherwise increase the up-take of training. DECC will also disseminate information on energy efficiency and promote available guidance and training through **WRAP's Facilities Management Strategy Group**[105] and via WRAP communications with the FM industry.

B.77 In the United States, a specialist energy efficiency training and certification programme, the Building Operator Certification programme, is estimated to have delivered a per person energy saving of 172,000 kWh according to an evaluation by the Northwest Energy Efficiency Alliance. The training consists of classroom learning and workplace projects and requires a time commitment of 74 hours. DECC also support new and emerging industry-led initiatives to promote and signpost high quality training across the range of energy management roles, with the aim of raising the profile of energy management and make it a core aspect of building and business management.

B.78 There is also an opportunity to improve skills relating to the installation and maintenance of building energy efficiency technologies, including energy management systems and renewable heat, and of technologies used in manufacturing production lines. This would target another area of significant potential described in the above Energy Efficiency MACC. We therefore welcome the work being carried out by the Sector Skills Councils – such as the 'Build up Skills' project – looking at current skill levels and the training needs that will need to be addressed to maximise energy efficiency. EEDO will also be initiating some further work **to identify specific training needs in the non-domestic sector, for example on the maintenance of energy management systems, energy auditing and the operation of industrial pumps and motors.** The work will focus on skills specific to the non-domestic sector and will assess: current levels of skill in these areas, the availability of training and skill provision; and options for increasing training provision and developing capacity.

105 www.wrap.org.uk/fm

Annex C: Barrier: Misaligned financial incentives

Misaligned financial incentives

Definition: It is not always the case that the person who is responsible for making energy efficiency improvements will receive the benefits of there actions. For example, in most cases commercial rented tenants are responsible for their own bills and therefore it is in their interest to reduce the bills, but contractual arrangements around landlord/tenants or facilities management may inhibit investment. Landlords are unlikely to invest unless they will realise the benefits in monetary terms. On a societal level, wider benefits such as security of supply or emission reductions are not directly felt by those making energy efficiency investments and, as a result, the decision to invest is based only on the benefits directly received. Therefore, energy efficiency investments are not prioritised as they might otherwise be. Figure 8 shows that, across the entire economy, energy costs can be a relatively small proportion of costs for many sectors, but in aggregate that energy use is a huge ask of our energy system.

What is already happening to address this barrier?

- The Green Deal and Energy Company Obligation
- Climate Change Levy/Climate change Agreements
- The CRC Energy Efficiency Scheme
- EU-Emissions Trading System
- The Enhanced Capital Allowance scheme

What more are we doing now?:

- Consider extending Green Deal
- Support for energy efficiency training of facilities managers; and
- The Electricity Demand Reduction project.

C.1 Misaligned financial rewards have been the subject of much policy scrutiny in the past. This is particularly true with regard to those nation-wide benefits that are not seen as specifically relevant to the individual.

C.2 Government can help align split incentives. For example, we can provide financial support to landlords and tenants who want to make energy efficient improvements. Where this does not work, Government can consider the need

to regulate to stimulate more take up of energy efficient improvements.

C.3 It is not, however, just the domestic sector where such considerations are needed. Our behavioural research indicates that non-domestic occupants are also reluctant to invest in 'embedded' energy efficiency measures because the payback periods are incompatible with lease lengths. Meanwhile the owner has no incentive, given they are not responsible for paying the energy bill. Split incentives such as this are not only relevant to buildings. For example, transport hire, whether it be for a car or a large shipping vessel[106], can suffer from the same problem, with the bill payer not always having enough information or influence to decide on the energy efficiency of the mode of transport. Figure 8 of this strategy clearly shows how these issues can aggregate across the economy.

Existing activity to address misaligned financial incentives

The domestic sector

C.4 This government has sought to address the split incentives issue through developing **the Green Deal**[107] with those benefiting from the energy efficiency finance funding it through their subsequent energy bills. If a new occupier moves in, they will take on the repayment, while still benefiting from the relatively lower energy bills resulting from the energy efficiency measure or measures that have been installed.

C.5 The Energy Act 2011 enables Government to regulate to help ensure the take up of cost effective energy efficiency improvements in the Private Rented Sector. From April 2016, domestic private landlords should not be able to unreasonably refuse requests from their tenants for consent to energy efficiency improvements, where financial support is available, such as the Green Deal and/or the ECO. Further, the Energy Act contains provisions for a minimum standard for private rented housing and commercial rented property from 2018, likely to be set at EPC band 'E'. The Government has committed to working with the sector in advance of any regulations to encourage uptake of energy efficiency measures through the Green Deal and confirms that any use of these regulation-making powers is conditional on there being no upfront or overall costs to landlords.

The non-domestic sector

C.6 We already have a number of targeted policies that, through making it a boardroom concern, encourage greater energy efficiency and so carbon reduction in the commercial and industrial sectors. The **EU-Emissions Trading System** (EU-ETS)[108] places a cap on emissions from electricity generation and the main energy-intensive industries, which collectively represent about half of UK CO_2 emissions, and drives the take up of least cost abatement, such as energy efficiency measures.

C.7 The **Climate Change Levy** (CCL) is a tax on the use of energy in industry, commerce and the public sector. It is led by HM Treasury and is levied on most business and public sector use via their suppliers. **Climate Change Agreements** (CCAs) provide eligible energy intensive industries with discounts on the CCL in return for meeting energy-intensive targets. In 2011/12 these discounts were estimated to be worth £135 million a year[109] and affected around 9000 facilities.

C.8 The **Enhanced Capital Allowance** (ECA) scheme was introduced in 2001 to increase the take up of energy efficient equipment by industry. It allows businesses to claim back

106 http://www.carbonwarroom.com/
107 See Annex A for more detail.
108 http://www.decc.gov.uk/en/content/cms/emissions/eu_ets/eu_ets.aspx
109 http://www.hmrc.gov.uk/stats/tax_expenditures/table1-5.pdf

100% tax relief on the qualifying energy efficient products for the tax year when the purchase was made. There are approximately 19,000 products on the Energy Technology List (ETL) that details the energy saving technologies that qualify for an ECA.

C.9 **The CRC Energy Efficiency Scheme (CRC)** was introduced in 2010 to encourage energy efficiency in large commercial and industrial organisations. The scheme requires participants to report on and purchase allowances on their energy usage/emissions and, so focusing attention on energy usage and incentivises greater energy efficiency.

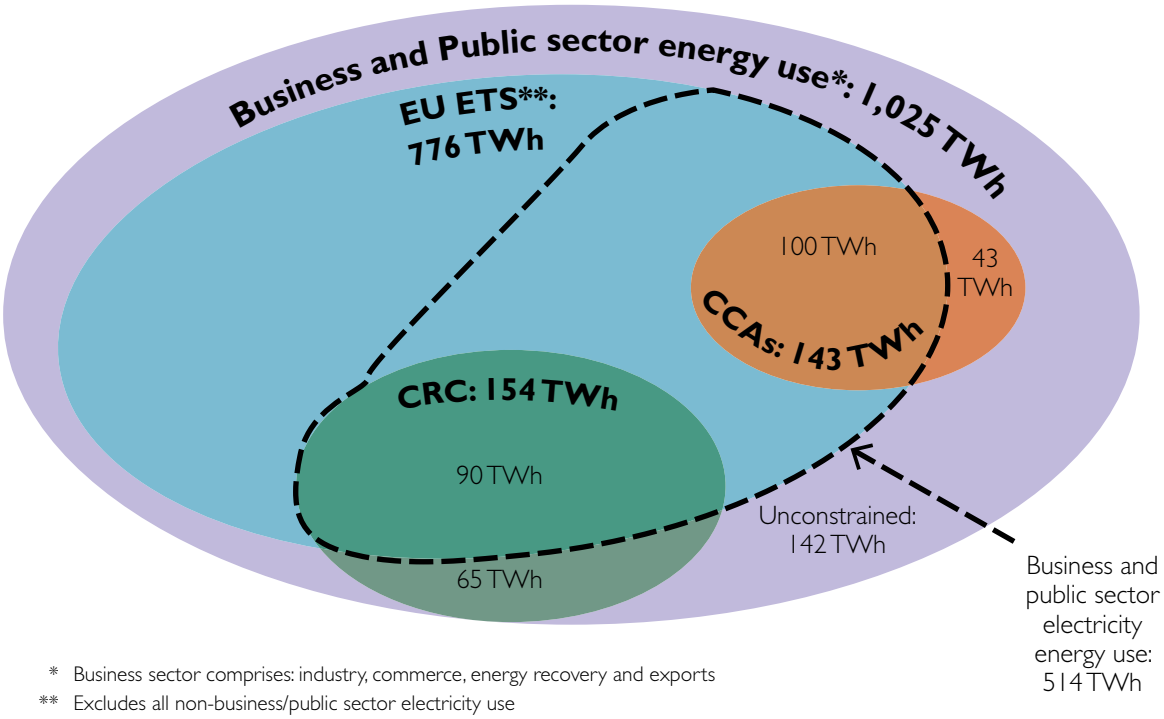
C.10 Figure 13 shows how the EU-ETS, CCAs and CRC Energy Efficiency Scheme fit within the scope of energy use in the business and public sectors. This Figure shows:

- ithe coverage of energy efficiency policies in terms of 2010 energy consumption;
- the size of the circles represents the amount of energy consumption covered by each scheme and shows the extent of overlap between the EU Emissions Trading Scheme; and
- that 14% of energy consumption in this sector is not covered by any of these policies.

C.11 While each policy regulation is targeted differently, enterprises can be caught by multiple regulation and we are in process of **simplifying the landscape**, removing overlaps. Actions taken include:

- consulting on and simplifying Climate Change Agreements reducing the administrative burden;

Figure 13: Estimated energy coverage of energy efficiency schemes in the business and public sectors, 2010[110]



* Business sector comprises: industry, commerce, energy recovery and exports
** Excludes all non-business/public sector electricity use

110 DECC Analysis of Digest of UK Energy Statistics, Greenhouse gas emissions inventory, CRC database, EU-ETS database and CCA database. The diagram represents position as at 2010 and does not reflect simplification proposals in ETS, CRC and CCA schemes published and consulted on in the course of 2011 which will come into effect in 2013 and beyond. Energy Efficiency Statistical Summary http://www.decc.gov.uk/eedo.

- introducing a small emitters (<25ktCO_2e a year) and hospitals opt out for the EU ETS (to address the disproportionate regulatory burden of the system on these installations) which offers savings of up to £80million over Phase III (2013-2020);

- we have consulted on a process for simplification of CRC which will significantly reduce administrative burdens for participants and remove overlaps with other schemes; and

- we have consulted on new regulations to implement the EU-ETS in the UK from 2013. The new regulations aim to simplify the legal requirements for UK EU ETS participants by consolidating 13 sets of regulations into a single regulator instrument.

Further activity to address misaligned financial incentives

The commercial and industrial sectors

C.12 **The Green Deal** is also open to the non-domestic sector, but it may not always apply, and there is more to be done, particularly in the commercial sector given the energy efficiency potential that has been identified. As noted in Annex A, we will consider how this model might be extended to other products. Better **training of facilities managers**, proposed in the previous annex will also play its part, potentially making the opportunity to save more apparent to the bill payer. The **Electricity Demand Reduction project** might also identify further options.

Annex D: Barrier: Undervaluing energy efficiency

Undervaluing energy efficiency

Definition: The lack of salience of energy efficiency increases the impact of hassle costs and behavioural barriers. Energy efficiency changes may involve significant hassle costs for those carrying out the investment, which increases the costs of the investment. For example, disruption caused by building works or disruption to production lines. Energy efficiency improvements may not be seen as strategic for a company and therefore not prioritised. For example, outside of the energy intensive industry sectors, energy bills are only a small proportion of business costs. If the relative gain is small, then the hassle costs can act as a significant barrier, especially if there is uncertainty around the benefits of the investment. While hassle costs are not a market failure, they compound the impact of other behavioural barriers, reducing investment in energy efficiency. This is often why companies are reluctant to invest in energy efficiency, seeking short payback times, even if a project is cost-effective at usual interest rates. Wider economic uncertainty is also reducing willingness to invest.

What is already happening to address this barrier?

- The Green Deal golden rule
- The CRC Energy Efficiency scheme

What more are we doing now?:

- Ensuring strong messaging around Green Deal and Smart Meters
- Developing a trial to study the impact of advice on how to use heating controls provided when boiler checks are carried out
- Announcing the forthcoming DECC Community Strategy; and
- Commissioning a Community Energy Efficiency Outreach Programme

D.1 As reflected in annexes A, B and C, energy efficiency is not salient for many consumers. Although a concern in the form of an energy bill, it is not top of people's minds. Other than reducing cost, there is no strong imperative to become more energy efficient and it is not seen as an important social goal. The challenge is how to engage consumers with energy efficiency in a way that is relevant for their lives, making it more likely that they take up energy efficiency measures. Very often consumers want to see evidence of success in situations like their own.

D.2 We have a number of policies which are focused on getting people to install energy efficient home improvements, and there is a reasonable understanding of the customer barriers and triggers for such 'one-off' purchasing decisions. However, one of the gaps we have identified and are working to fill is around better understanding of how every day, habits at home could use less energy. These are broad ranging activities, such as taking shorter showers and using radiator valves to turn off heating in unused rooms.

The domestic sector

D.3 In the domestic sector there is the potential to use less energy through habitual behaviour change without reducing levels of comfort. This is true even among the lowest of gas users[111]. There is evidence to suggest that enhanced billing, which provides comparisons between your home and the average user, could save around 4% of household electricity use[112]. Under some circumstances, savings per household can be higher. For example, community and team-based projects to change behaviour can result in savings of around 5-15%[113]. Behaviour change should also be considered alongside other changes people could make in their home, such as installing insulation or new low carbon heating systems[114]. This is because larger energy savings are likely to result from considering the person in the home, the social system of which they are a part and the technologies they have installed[115].

D.4 Some people have more potential to save energy than others, and everyone uses energy in their homes in different ways. There is, for example, a huge range in the amount of gas used by different households, with the highest users consuming four time more than the lowest[116]. Analysis from the National Energy Efficiency Data-framework[117] has shown that less than 40% of the variability in gas use comes from the size, age and type of property as well as household income and tenure[118]. In addition, external evidence shows that households with more scope to reduce energy use appear more likely to experience larger savings in energy use[119]. There is a case for targeting policies at those who have the most potential to enable them to save energy.

111 Detailed qualitative research with 70 3-bed, semi-detached, owner-occupied, gas centrally heated households, found opportunities for all to use less heat without reducing levels of comfort. This included 28 exceptionally high and 25 exceptionally low gas consumers: amongst the highest or lowest 10 percent for households with that level of income. Whilst highest gas consumers could save more, findings showed that even many of the lowest could stay warm and spend less. See the research report for more detail: DECC, 2012, Why do comparable homes use such different amounts of energy?

112 ACEEE, 2010, Advanced metering initiatives and residential feedback programs: a meta-review for household electricity savings opportunities.

113 DECC, 2012, What works in changing energy using behaviours in the home? A rapid evidence assessment.

114 Carroll, D. and Berger, J, 2008. Transforming Energy Behavior of Households: Evidence from Low-Income Energy Education Programs: Washington, D.C. Alliance to Save Energy.

115 For more detailed discussion see: Shove, E, 2003. Comfort, cleanliness and convenience. Oxford.

116 NEED data was analysed to compare the highest and lowest 10% of gas consuming households.

117 DECC National Energy Efficiency Data-framework 2012, Annex E.

118 Rented, owner-occupied, council or social housing..

119 DECC, 2012, What works in changing energy using behaviours in the home? A rapid evidence assessment.

D.5 Some changes in behaviour could save more than others[120]. The table below gives some examples of some small, everyday changes people could make in their homes, and how much energy it might save annually. Changes to how heat in the home is used and managed has the potential to save the most energy, when compared to other, everyday household behaviours (for example, not overfilling the kettle has the potential to save around an average of 100kWh per household per year, compared to over 3000 kWh for turning the thermostat down from 20 to 18°)[121]. To maximise the potential from behaviour change,

Figure 14: Table of energy saving from different domestic behaviours

Target behaviour change[122]	Estimated saving per household per year (kWh)[123]	% of total household energy consumption
Turn thermostat down by 2 degrees from 20C to 18C (modelled)	3,093	17%
Insulate water tank using a thermal jacket (modelled)	2,887	15%
Turn thermostat down by 1 degree from 19C to 18C (modelled)	1,528	8%
Wear a thick jumper at home in the heating season (modelled)	1,528	8%
Install water efficient shower head and use twice every day	811	4%
Delay start of heating from October to November (modelled)	667	4%
Use radiator valves to turn off heating in unused rooms (modelled)	531	3%
Close bedroom window at night instead of leaving a little open (modelled)	417	2%
Regularly maintain heating system: use chemical inhibitor to reduce sludge and scale in the heating circuit and bleed radiators regularly	389	2%
Install cylinder thermostat and use to control tank temperature (modelled)	368	2%

120 DECC, 2012, How much energy could be saved by making small changes to everyday household behaviours?

121 Caution is needed when interpreting the estimates for turning the thermostat down by two degrees, in practice this is unlikely to reflect how people actually use their heating controls. Research has shown that many people will turn their thermostat up and down regularly as needed (DECC, 2012, Why do comparable homes use different amounts of energy?).

122 The term 'behaviours' is used to represent 'observable actions' which can be quantified for comparison purposes and to give a sense of the scale of the potential. We recognise that these 'behaviours' may not actually reflect how people actually behave, and use energy, in the home.

123 The savings from different behaviours cannot be added together simply, because successive behaviour changes have complex inter-relationships. If a household installs a low-flow shower head and takes shorter showers, for example, then total savings will be less than adding the two estimates of savings per household for these two behaviours.

messaging and advice should focus on those behaviours with the potential to save the most energy.

D.6 Energy efficiency is a complicated, and emotive, issue. People tend to think of energy efficiency in terms of turning off lights and not over filling kettles, rather than managing how they heat their home and how they use appliances[124]. Energy efficiency needs to become more salient to engage people enough to change their behaviour. There may be opportunities to tackle the myths around domestic energy efficiency, and these should be explored. There is also an issue around saliency and energy bills, in some cases energy bills do not make up a high enough proportion of household spend to make saving money on them pressing. Also, monthly direct debits appear to cut people off from being aware of that consumption.

D.7 We have some understanding of what can encourage people to use less energy in the home, but more work is needed to develop our knowledge in this area. A recent review of evidence[125] showed that people do respond to interventions which focus on changing habitual behaviour, however some appear more successful than others. This evidence suggests that interventions tend to result in higher levels of savings when including tailored instructions or comparative feedback. Further trials and pilots are needed in this area to help us be more certain about what works in changing people's energy using behaviour in the home.

D.8 There are a number of additional opportunities for improving how we work in this area and how we learn from others, such as through increased collaboration with local partners and front line delivery bodies. These organisations are much closer to customers and their circumstances, and so deliver a greater level of personalisation to make policies more salient. We know that there are innovative and interesting examples of projects designed to change domestic energy using behaviour out there, however, they are often not accompanied by robust evaluation, and learning can be lost. The way research is conducted in this area, and the impact measured, needs to be strengthened so we can improve the evidence base and build on experience.

Non-domestic

D.9 Further to the domestic literature review, EEDO has led on a study to examine the factors influencing behaviour and decision making in the non-domestic sector[126]. The study highlighted the need to complement traditional economic thinking about business decision making by taking into account the broader social and cultural context in which decisions take place.

D.10 Like the domestic sector, the salience of energy efficiency plays an important role in the non-domestic sector. Energy efficiency investments are much more likely to be adopted if they fit with a company's strategic objectives. For example, building a strong corporate reputation or maximising employee productivity.

D.11 Linked to the above, decision making processes generally have a beginning, where

124 DECC, 2012, Why do comparable homes use such different amounts of energy?
125 DECC, 2012, What works in changing energy using behaviours in the home? A rapid evidence assessment.
126 DECC, 2012, Evidence review of energy efficiency behaviours in the non-domestic sector: What are the factors influencing energy behaviours and decision-making in the non-domestic sector?

new ideas are noticed and become salient; a middle, where options and potential solutions are identified; and an end, where options are considered and a decision made. The beginning and middle of the decision making process are often neglected in policy making but the culture of organisations influence what is noticed and taken forward; some organisations will find messages on competitiveness more salient while others are more likely to notice information on regulation or environmental responsibility. This suggests a need to ensure that DECC and the market develop a range of messages on energy efficiency which appeal to the different cultures of organisations. More work is needed to understand what makes energy efficiency strategically attractive for different organisations and DECC will be exploring this in future as part of the work developing the approach to audits.

D.12 As well as culture, the size, structure and sector of an organisation also has an influence on energy efficiency. Firms with a dedicated energy manager are more likely to have an energy efficiency strategy, and the closer in the hierarchy the energy manager is to the CEO, the more likely that energy management will happen. Internal energy management systems also ensure that energy use is visible and salient, helping to increase the focus on energy efficiency at board level.

D.13 Policy should therefore support businesses in developing the capacity to implement effective internal energy management. There is also a need to raise the strategic profile of energy efficiency so that the importance of energy management- and energy managers, is recognised at board level. The Green Business Awards is one way to do this. In smaller firms where the owner or director is responsible for energy efficiency, but has little time to consider, it is accessible advice from external advisors will be key.

Existing activity on valuing energy efficiency

Domestic

D.14 As Annex B sets out, there is much we are doing and more we will do improve information to consumers, whether businesses or households. But information alone may often fail to change behaviours. The Government is therefore looking at ways to either increase the value people attach to energy efficiency or reduce the value they assign to hassle and other issues to overcome.

D.15 The Green Deal is explicitly designed to capture the value of change for a consumer. The assessment makes clear what could be saved and the **Golden Rule** is set to ensure that customers will not pay back more than a typical bill payer can expect to save on their energy bill. Once the property has been refitted, Green Deal providers will be repaid by successive bill payers, most likely the occupants of the building, who will benefit from the measures installed. This is the big change: payments can be made not just by the current occupier, but by successive occupants. In this way, the first occupant to take a Green Deal only has to weigh value to them whilst in the property against the repayments whilst in the property, and not against the total cost of the measure.

D.16 As well as confirming relevant fabric measures the Green Deal assessment goes on to cover ways in which the occupant can reduce energy costs. Green Deal also allows for greater competition in energy efficiency offers to consumers and there is already evidence of innovation in services to reduce hassle such as loft clearance. The development of technology around heating controls will allow people much easier ways to keep rooms at required temperatures.

D.17 Community engagement will often be the way to increase the value people assign to energy efficiency. A Community Champions scheme is in place to generate Green Deal demand and to address Fuel Poverty we have launched a £25m Local Authority competition fund, targeting distribution by year end to those eligible for Warm Front. Smart meters will make energy consumption transparent and tangible, potentially encouraging further energy efficiency measures. We are exploring ways of working with community groups to encourage the take up of smart meters in geographical communities and by different customer types from 2014.

D.18 In September 2012, DECC announced the launch of a new community energy fund with £10 Million available to help local communities develop energy projects. The fund which is managed by a number of community networks, including Local United, and administered by the Energy Saving Trust, will be run as a competition. There will be the chance for around 200 community organisations to take advantage of the fund and get to grips with energy efficiency and renewable energy generation.

Non-domestic

D.19 Green Deal and community/sector approaches may also help with non-domestic consumers. In terms of businesses and the public sector, one other way to increase the value attached to energy efficiency and drive behaviour change is to report performance. In central government, for example, we are working towards a **25% target** for emissions reductions and there is an annual report on how well Departments are doing (see box 5). The first annual report will soon be available.

D.20 The **CRC Energy Efficiency Scheme** requires just over 2000 large and public sector organisations to report annually on their energy usage and to purchase allowances based on their level of consumption. This policy is projected to deliver emission reductions of around 29MtCO_2 by 2027. The CRC Energy Efficiency Scheme projected to save 9TWh of energy in 2020, relative to business as usual. This accounts for 5 per cent of total energy savings from the current policy package in 2020[127].

Further activity on valuing energy efficiency

Energy Efficiency messaging

D.21 We know that over half of people are worried about their energy bills and that eight in ten give a lot or a fair amount of thought to saving energy in the home[128]. However, many people are not aware of the steps they could take to improve the thermal efficiency of their property. A quarter of people have not heard of solid wall insulation and 41% have not heard of a ground source heat pump[129].

D.22 Although people may be aware of the term 'energy efficiency', this might not mean they are aware of the activities that could help them become more energy efficient. Recent Which? research found that many people are unclear what they should be doing on energy efficiency, and did not think of it as a clearly defined concept, but a series of measures that could be done separately[130].

D.23 Whether in the domestic sector or in other sectors, there is a clear need to improve the messaging around energy efficiency. However, this messaging needs to be appropriately tailored given that, even within a

127 This represents savings in the traded and non-traded sector from DECC Updated Energy and Emissions Projections, October 2012. These savings do not reflect scheme simplification proposals published and consulted on in the course of 2012 and which will come into effect in 2013 and beyond.
128 DECC, 2012, DECC public attitudes tracking survey: Wave 1 http://www.decc.gov.uk/en/content/cms/statistics/public_att/public_att.aspx
129 Ibid.
130 Highlights from our recent energy research, Which?, February 2012.

CASE STUDY 15: Wessex water energy saving initiative – staff bonuses

Saving energy has been a big challenge for Wessex Water and its employees over the past few years, **but last year the company helped save £1 million against its budget thanks in part to an energy bonus scheme which encourages staff to cut the firm's energy consumption.**

In the first year of the scheme the cumulative consumption of electrical energy (KWh) at every Wessex Water site was measured and compared against the budgeted consumption for that site. Measurements were taken monthly and a bonus was paid based on the cumulative performance at the end of every three month period. Bonuses were awarded to those areas whose consumption was 1% or more under budget. Once it was established that savings could also be made through avoiding high tariffs the bonus was measured against a financial target, rather than kWh.

sector, consumers will prioritise the multiple benefits of energy efficiency differently. For example, one household might prioritise keeping the home warm, while another might be more motivated by reducing their energy bill or not wasting energy.

D.24 **We are looking at how we communicate the benefits of energy efficiency to make it more salient for consumers through our policy work on Green Deal and Smart Meters.** We have brought in an external communications planning agency to help us develop a robust, structured and costed consumer engagement plan for the Green Deal. We have also published proposals for a Smart Meters Consumer Engagement Strategy to ensure the consumer benefits for the programme are well understood and realised at the household level and amongst small businesses.

Influencing the boardroom

D.25 The non-domestic literature review findings have shown that energy efficiency investments are sometimes assessed differently from other investments, with businesses often wanting higher rates of return. Where investment finance and/or management time is limited, companies may make decisions between investments to deliver cost savings (e.g. through energy efficiency improvements) or expansion, with the ultimate goal of increasing value for shareholders. This is something that could be addressed through the implementation of energy audits requirement under the EU Energy Efficiency Directive. Given the potential we have identified in the commercial sector, we will work to understand the business cultures that prioritise energy efficiency enough to consider it as an investment proposal in the first place and, at the decision making stage, what type and quality of information is generally required and by who.

Using the front line

D.26 The importance of influencing the way we heat our homes has already been discussed. Some of the highest impact energy saving behaviours in the home include those that do not involve buying and/or installing anything additional. For example, turning a thermostat

down by two degrees centigrade results in roughly equivalent savings to installing cavity wall insulation[131].

D.27 There are, however, barriers to overcome. A recent Consumer Focus review[132] highlighted that action became more difficult where displays were difficult to read, there was a lack of intuitive design, poor positioning of controls and a lack of effective supporting information and advice. They found that consumers often do not accurately grasp how their heating controls work with their heating system, and how this relates to energy use. As a result, many consumers do not use their controls as intended, in a cost effective way, or in some cases, do not use them at all.

D.28 DECC is interested in any further evidence around the impact of interventions to improve consumer awareness, understanding and knowledge of how people use their existing heating controls properly. **DECC is developing plans for a heating controls trial in Newcastle**, working with the City Council and the social housing provider, Your Homes Newcastle. The trigger point for the intervention is the annual gas boiler check that all landlords are required to do. The aim of the trial is to test whether the provision of tailored advice on heating controls (review central heating/hot water programmers, TRVs, thermostat levels), compared with a 'leave behind' leaflet, maximises householders' use of heating controls to save energy.

Eco driving

D.29 In 2010, road transport accounted for 92% of total domestic transport greenhouse gas emissions, with cars alone accounting for 56%. By applying eco-driving techniques, such as the less aggressive use of the accelerator and brakes, the carbon emissions from a car could potentially be reduced by 8%.

D.30 The Department for Transport currently supports and promotes eco-driving through work with the Energy Saving Trust to offer advice and subsidised smarter driving lessons for businesses. For learner drivers, the Driving Standards Agency (DSA) have incorporated eco-driving into the learner driver syllabus and both the theory and practical parts of the driving test.

D.31 EEDO will work with the Department of Transport to explore additional way of **promoting eco-driving over and above what is already being done**. Motor standards are influencing the technology in this area, but there is significant energy efficiency potential to be realised though the way that we use this technology when we drive. For example, evidence may suggest that some technologies help to reinforce eco-driving training and maximise its benefits.

Harnessing collective action

D.32 As we act on this strategy we will explore in more detail the role of collective action, not only in terms of collective buying, but in terms of community support for those who, for example, cannot clear their own lofts. In the first instance, DECC is working with stakeholder groups to develop a **Community Energy Strategy** that will support activity with communities across the Department. This strategy will inform how the Department works with community groups and local organisations across all aspects of buying, saving and generating energy, and make sure our community schemes are fit for purpose. The DECC Community Energy Strategy is to be developed over the coming months, and will be available for use from Summer 2013.

131 The annual saving per household from turning the heating down from 20° to 18° is estimated at around 3000 kWh (DECC, 2012, How much energy could be saved by making small changes to everyday household behaviours?), the savings from installing cavity wall insulation is estimated at 1700 kWh per year (DECC, 2012).

132 http://www.consumerfocus.org.uk/files/2012/01/Consumers-and-domestic-heating-controls-a-literature-review.pdf

D.33 In order to inform future policy making in this area, DECC will also commission **the 'Community Energy Efficiency Outreach Programme'**, a pilot testing the efficacy of community-based engagement in promoting energy efficiency measures. The programme will engage the Community Energy Practitioners Forum led by Groundwork UK, a third sector organisation, to manage a short-term 'test and learn' initiative designed to develop an understanding of the best practice methods of engaging residential and business communities in collective action on energy efficiency.

D.34 The programme will help DECC and our commercial delivery partners understand how best to use community and business networks as a route to deliver energy efficiency measures. It will explore the feasibility of developing a large scale community outreach initiative which could be mobilised to drive early demand for measures and create entry level jobs for the long-term unemployed. It will also help community organisations and third sector networks understand how they can benefit from DECC policies to pursue their collective aspirations.

D.35 At an organisational level, there is the opportunity to make energy savings through employee engagement and workplace initiatives, with a focus on information sharing and training employees. DECC recognises that there is a need for good quality guidance to support organisations in helping employees adopt to energy efficient behaviours and improved evaluation of what works. Given this we welcome the sharing of case studies and best practice and would encourage organisations to evaluate interventions and make available evidence on what works in changing energy behaviours.

Annex E: The Energy Efficiency Marginal Abatement Cost Curve

Introduction

E.1 This annex sets out estimates of the potential for realising increased energy efficiency based on a UK wide Energy Efficiency Marginal Abatement Cost Curve (EE-MACC). The EE-MACC estimates the energy savings, measured in terms of final energy consumption that could be achieved in a given year through implementing energy efficiency measures between now and that year. Measures are included in the EE-MACC if they have the potential to reduce the amount of energy needed to deliver energy services to a consumer, for example in the domestic setting insulation reduces the amount of gas needed to heat a home to the desired temperature, or in an industrial setting buying new equipment that reduces the amount of energy to produce the same level of output[133].

Overall potential for energy efficiency

E.2 We estimate that through socially cost-effective investment in energy efficiency we could be saving 196TWh in 2020, equivalent to 22 power stations. We have estimated the impact of realising energy efficiency measures relative to a baseline that excludes policies that have been introduced since 2009[134]. The impact of implementing these cost effective measures by 2020 could lead to energy consumption 11% lower than under business as usual projections of final energy demand. By 2025 the cost-effective measures could save 244TWh, which could lead to energy consumption 13% lower than under business as usual projections of energy demand. For more detail on the methodology of the EE-MACC see box E1.

E.3 Energy efficiency is often a cost effective route for carbon abatement, reducing carbon emissions in both the traded and non-traded sectors. If the cost-effective energy efficiency measures were realised it would save 41MtCO_2e in 2020 and 40MtCO_2e 2025. For a more detailed comparison of the cost effective potential for carbon abatement between energy efficiency and other options, see the Carbon Plan[135].

133 Final energy consumption in this analysis differs slightly from that used in National and International statistical reporting, since in this analysis combined heat and power (CHP) has been included on the basis that it reduces the need for gas to produce heat. It is more usual to include elements of CHP energy use within primary energy demand.

134 For more detail on DECC's energy and emissions projections, see DECC, Updated Energy and Emissions Projections, October 2012.

135 DECC, Carbon Plan, December 2011.

E.4 Our estimates of the energy savings from insulation take into account the rebound effect (comfort taking). The direct rebound effect is where in response to lowering the cost of energy services as a result of an energy efficiency measure, the consumer increases demand for that energy service, for example, if households previously living in cold properties take advantage of the relatively lower costs associated with meeting a desired internal temperature by consuming more energy. The direct rebound effect in the business setting is where a company produces more output once energy costs of production are lowered. This direct rebound effect is beneficial to society (it enhances the welfare of those that consume the energy) but reduces the energy savings associated with measures in particular circumstances (offsetting some of the welfare gains from the additional consumption). Energy efficiency measures can also have an indirect rebound effect – households and businesses who reduce the costs of delivering the energy services they demand will free up income to spend on other goods and services, some of which will require energy in their production or consumption. As set out in the overview, this supports economic growth.

Box E1: Methodology of the Energy Efficiency Marginal Abatement Cost Curve

The purpose of a marginal abatement cost curve is to present all the measures that can potentially reduce energy consumption (or more usually, carbon emissions) on a consistent basis. The x-axis measures the size of the energy saving in a given year, relative to the level of energy consumption that would be seen in the absence of these measures. The EE-MACC estimates the energy savings that would be achieved in a given year through implementing energy efficiency measures between now and that year.

The y-axis represents the cost effectiveness of a measure. In the EE-MACC this is defined as the net present value divided by the lifetime energy savings. This cost-effectiveness metric represents the net cost of saving a MWh of energy over the lifetime of the project. Measures that are below the line have negative costs over their lifetime, which means that the discounted sum of benefits outweighs the discounted costs of that measure.

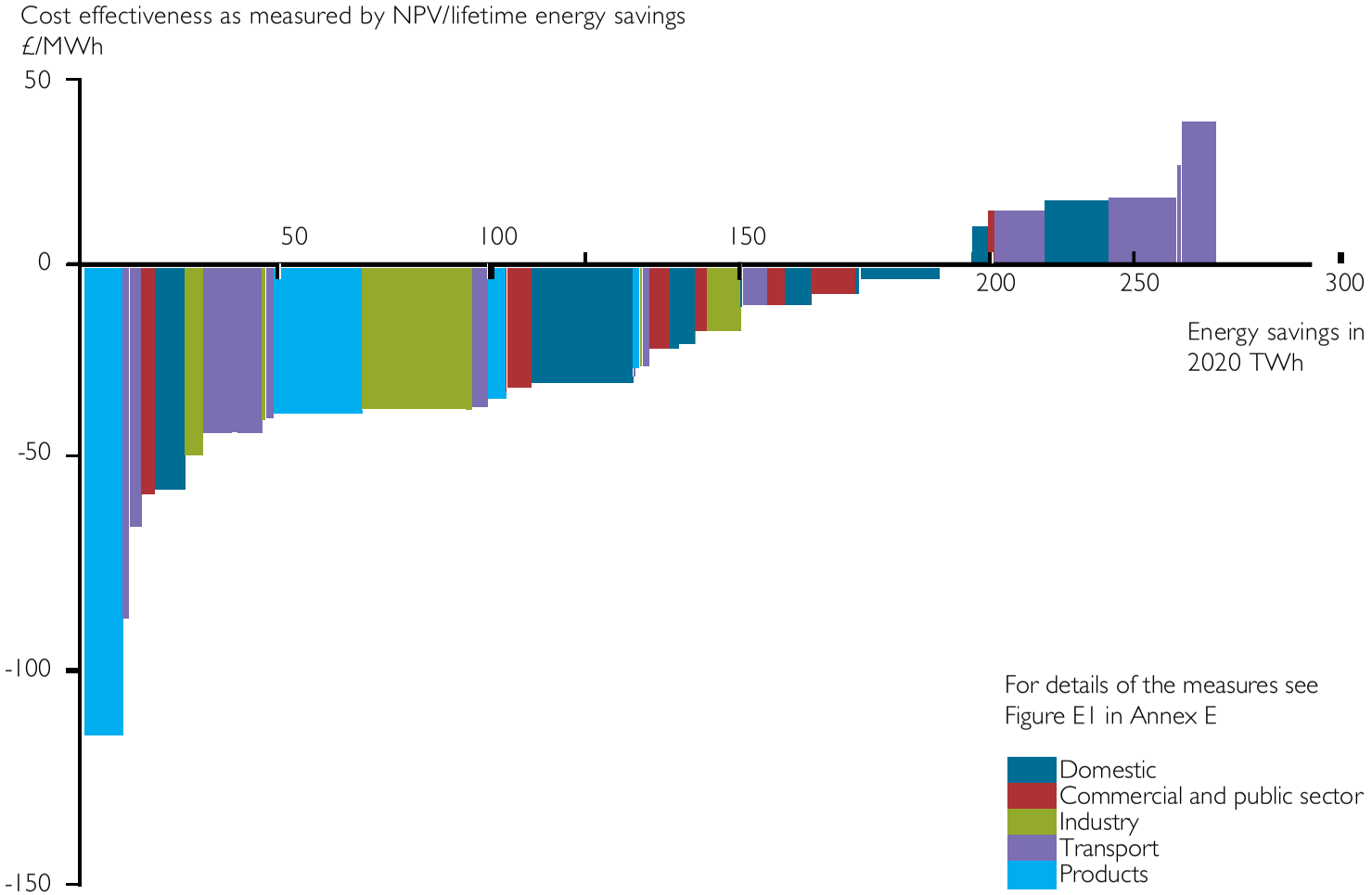
Measures are valued according to the social perspective in line with the appraisal guidance set out in the Green Book[136] and the supplementary guidance provided by the Inter-departmental Analysts' Group on valuing carbon emissions avoided, energy savings and air quality improvements[137]. The social discount rate has been used for discounting the future. Capital costs are assumed to be paid upfront and financing costs are excluded. A measure that is cost-effective from the societal perspective may not be cost effective for the individual investor (and vice versa).

The potential for energy efficiency improvements has been assessed relative to a business as usual baseline that excludes policies that have been introduced since 2009. The energy projections and their underlying assumptions were published by DECC in October 2012[138]. The baseline assumes that there is continued improvement in energy efficiency, therefore the EE-MACC represents the energy savings that could be delivered over and above that which is delivered through "business as usual" improvements. This baseline means that the EE-MACC includes measures covering energy savings from policies introduced since 2009.

The EE-MACC is based on an estimate of the feasible rollout of energy efficiency measures from 2012 and is broadly consistent with the analysis set out in the Carbon Plan[139] for high ambition scenarios for delivering further carbon abatement during the 4th carbon budget period. The assessment of feasibility takes into account supply constraints for energy efficient products, only including technology that is available in the market. For example in the industrial setting it is assumed that investment in energy efficiency is only made at the natural point of replacement for existing equipment. Cost reductions over time have been assumed for some measures, but innovation in energy efficiency technology could enable greater levels of cost-effective energy efficiency investment in the future.

136 HM Treasury, The Green Book: Appraisal and Evaluation in Central Government.
137 HM-Treasury, DECC, Valuation of energy use and greenhouse gas (GHG) emissions, October 2012.
138 DECC, Updated Energy and Emissions Projections 2012, October 2012.
139 DECC, Carbon Plan, December 2011.

Figure E1: 2020 Energy Efficiency Marginal Abatement Cost Curve



Notes:

Consistent with the 2012 DECC energy projections and supplementary Green Book Guidance appraisal guidance. The business as usual baseline excludes policies that have been introduced since 2009. The net present values are calculated in 2012 terms.

Products policy estimates become increasingly uncertain beyond 2020, where the market may naturally deliver more efficient products – this will be reviewed in future. The energy savings from Tranche 1 and 2 of products policy within the industrial sector have been included in the potential for energy savings in industry.

Smart meters estimates are consistent with cost and savings assumptions as applied in the smart meter impact assessment and costs required for the delivery of the policy are taken into account (i.e. not only the asset costs for the provision of the technology are reflected). To be consistent with the methodology used here, financing costs have been excluded.

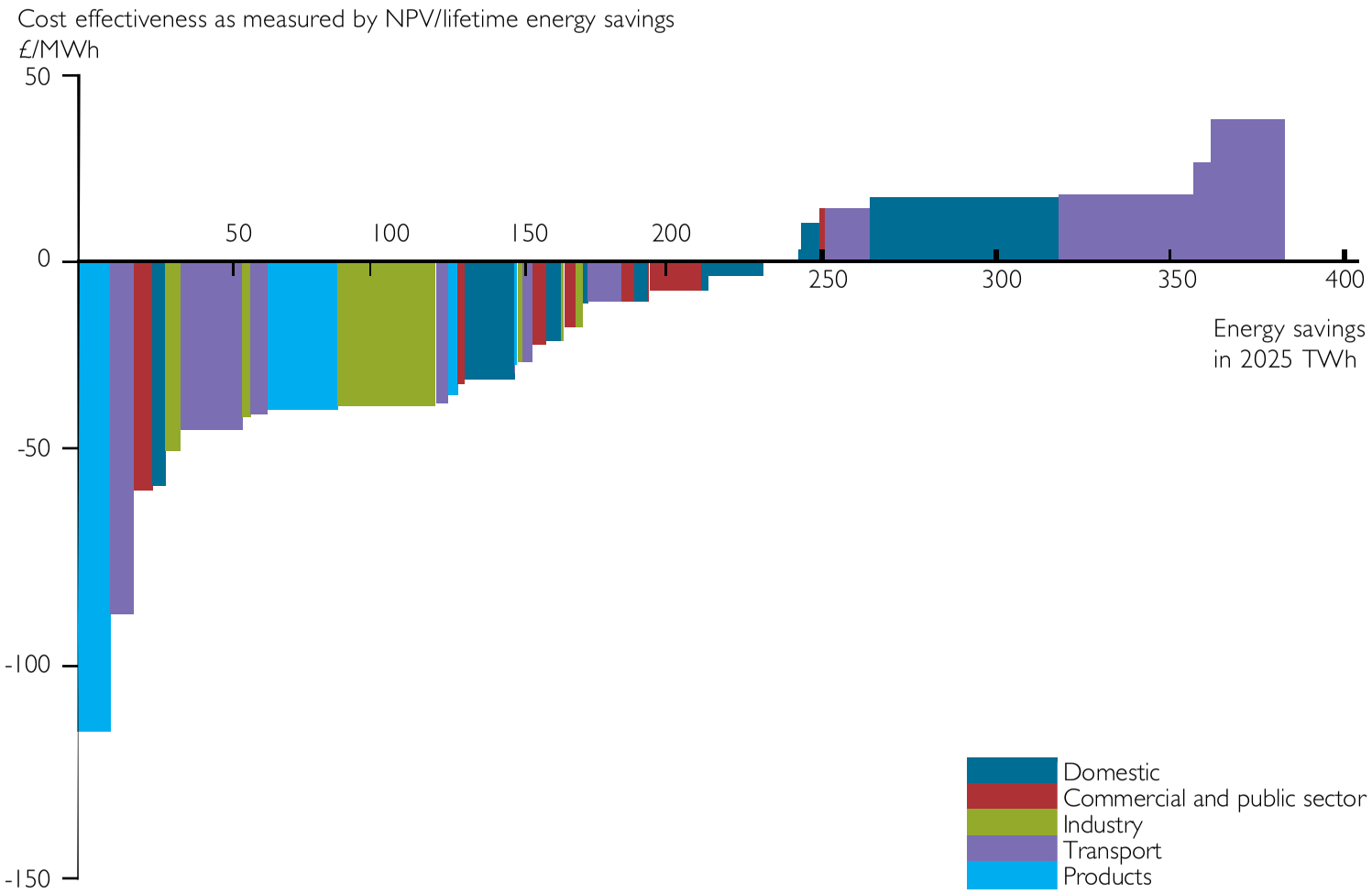
The transport analysis is consistent with that included in the Carbon Plan (December 2011). The assumptions, on fuel prices and growth for example, have not been revised since.

Estimates for the energy savings from CERT (20% uplift and extension) and CESP are consistent with the projected net energy savings set out in the DECC energy projections. The estimates of energy savings is net of comfort taking, but we have not valued comfort taking for these measures. The NPV for these policies is estimated based on discounting to 2009.

Energy savings in 2020

Name of measure	Energy saving (TWh)	Name of measure	Energy saving (TWh)
Products: Best Available Technology Domestic Lighting	0–1	Domestic: 2010 Part L New Homes	136–138
Transport: Rail Electrification - Great Western Main Line and North West Lines	1–1.5	Domestic: Easy to Treat Cavity Insulation	138–141
Products: Aggregate Tranche 1 Policy	1.5–13	Industry: Glass	141–141
Transport: Sustainable Travel - 6% Reduction in Car Trips	13–14	Commercial: 2010 Part L New Non-Domestic	141–144
Transport: Local Sustainable Travel Fund (LSTF)	14–16	Industry: Additional Industrial Retrofit Measures	144–150
Commercial: Retrofit Lighting	16–19	Domestic: Loft Insulation	150–151
Domestic: Smart Meters	19–27	Transport: EU Van Regulation of 147gCO_2/km in 2020	151–156
Industry: Iron & Steel	27–32	Commercial: Ground Source Heat Pumps	156–159
Transport: New Car CO_2 Mid-Term Target of 130gCO_2/km in 2015	32–44	Domestic: Hard to Treat Cavity Insulation	159–164
Industry: Chemicals	44–45	Commercial: Part L 2013: New Non-Domestic Buildings	164–165
Transport: HGV Technology Measures	45–47	Commercial: Air Source Heat Pumps	165–174
Products: Aggregate Tranche 2 Policy	47–68	Domestic: 2013 Part L Existing Homes - Extensions and Windows	174–175
Industry: Light Manufacturing Sectors	68–95	Domestic: 2010 Part L Existing Homes	175–190
Industry: Cement	95–97	Transport: Extension of Industry Led Action for HGVs High Scenario	190–196
Transport: HGV Low Rolling Resistance Tyres	97–100	Domestic: 2013 Part L New Homes 8% Uplift (FEES plus Efficient Services)	196–197
Products: Best Available Technology Domestic Appliances	100–103	Domestic: External Solid Wall Insulation	197–200
Commercial: Retrofit (Heating Products)	103–104	Commercial: CHP	200–201
Commercial: Smart Meters	104–109	Transport: EU New Car Complementary Measures	201–211
Domestic: CESP	109–109	Domestic: Air Source Heat Pumps	211–226
Domestic: CERT (20% Uplift and Extension)	109–129	Domestic: Internal Solid Wall Insulation	226–236
Transport: Additional Rail Electrification Midland Mainline & Welsh Valleys	129–129	Domestic: Ground Source Heat Pumps	236–245
Products: Best Available Technology Motors (Commercial and Government)	129–130	Transport: New Car CO_2 Target of 95gCO_2/km in 2020	245–260
Industry: Food & Drink	130–131	Transport: Average New Van Target of 75gCO_2/km in 2030	260–261
Transport: Low Carbon Emission Buses	131–132	Transport: Average New Car CO_2 Target of 50gCO_2/km in 2030	261–268
Commercial: Retrofit Insulation	132–136		

Figure E2: 2025 Energy Efficiency Marginal Abatement Cost Curve



Notes:

Consistent with the 2012 DECC energy projections and supplementary Green Book Guidance appraisal guidance. The business as usual baseline excludes policies that have been introduced since 2009. The net present values are calculated in 2012 terms.

Products policy estimates become increasingly uncertain beyond 2020, where the market may naturally deliver more efficient products – this will be reviewed in future. The energy savings from Tranche 1 and 2 of products policy within the industrial sector have been included in the potential for energy savings in industry.

Smart meters estimates are consistent with cost and savings assumptions as applied in the smart meter impact assessment and costs required for the delivery of the policy are taken into account (i.e. not only the asset costs for the provision of the technology are reflected). To be consistent with the methodology used here, financing costs have been excluded.

The transport analysis is consistent with that included in the Carbon Plan (December 2011). The assumptions, on fuel prices and growth for example, have not been revised since.

Estimates for the energy savings from CERT (20% uplift and extension) and CESP are consistent with the projected net energy savings set out in the DECC energy projections. The estimates of energy savings is net of comfort taking, but we have not valued comfort taking for these measures. The NPV for these policies is estimated based on discounting to 2009.

Energy savings in 2025

Name of measure	Energy saving (TWh)	Name of measure	Energy saving (TWh)
Products: Best Available Technology Domestic Lighting	0–0.1	Domestic: Easy To Treat Cavity Insulation	161–166
Transport: Rail Electrification - Great Western Main Line and North West Lines	0.1–0.5	Industry: Glass	166–166
Products: Aggregate Tranche 1 Policy	0.5–10	Commercial: 2010 Part L New Non-domestic	166–170
Transport: Sustainable Travel - 6% Reduction in Car Trips	10–17	Industry: Additional Industrial Retrofit Measures	170–172
Commercial: Retrofit Lighting	17–22	Domestic: Loft Insulation	172–173
Domestic: Smart Meters	22–30	Transport: EU Van Regulation of 147gCO_2/km in 2020	173–183
Industry: Iron & Steel	30–36	Commercial: Ground Source Heat Pumps	183–188
Transport: New Car CO_2 Mid-term Target of 130gCO_2/km in 2015	36–53	Domestic: Hard To Treat Cavity Insulation	188–196
Industry: Chemicals	53–55	Commercial: Part L 2013: New Non-domestic Buildings	196–196
Transport: HGV technology measures	55–60	Commercial: Air Source Heat Pumps	196–211
Products: Aggregate Tranche 2 Policy	60–86	Domestic: 2013 Part L Existing Homes - Extensions and Windows	211–213
Industry: Light Manufacturing Sectors	86–118	Domestic: 2010 Part L Existing Homes	213–234
Industry: Cement	118–120	Transport: Extension of Industry Led Action for HGVs High Scenario	234–244
Transport: HGV Low Rolling Resistance Tyres	120–123	Domestic: 2013 Part L New Homes 8% Uplift (FEES plus Efficient Services)	244–245
Products: Best Available Technology Domestic Appliances	123–127	Domestic: External Solid Wall Insulation	245–250
Commercial: Retrofit (Heating Products)	127–128	Commercial: CHP	250–251
Commercial: Smart Meters	128–132	Transport: EU New Car Complementary Measures	251–264
Domestic: CESP	132–133	Domestic: Air Source Heat Pumps	264–289
Domestic: CERT (20% Uplift and Extension)	133–147	Domestic: Internal Solid Wall Insulation	289–304
Transport: Additional Rail electrification Midland Mainline & Welsh Valleys	147–147	Domestic: Ground Source Heat Pumps	304–319
Products: Best Available Technology Motors (Commercial and Government)	147–149	Transport: New Car CO_2 target of 95gCO_2/km in 2020	319–358
Industry: Food & Drink	149–150	Transport: Average New Van Target of 75gCO_2/km in 2030	358–362
Transport: Low Carbon Emission Buses	150–152	Transport: Average New Car CO_2 Target of 50gCO_2/km in 2030	362–383
Commercial: Retrofit Insulation	152–159		
Domestic: 2010 Part L New Homes	159–161		

Comparison to projected policy delivery

E.5 It is possible to draw some tentative conclusions from the potential for reducing energy demand captured by the EE-MACC and to make comparisons with projections of energy savings from policy. Given the generalised nature of the analysis, these conclusions are broad, and any identification of further potential for energy efficiency does not in itself imply a need to develop policy solutions to bring it about. Further work on understanding the potential for energy efficiency and assessing effectiveness of existing policy measures is being taken forward to improve the robustness of estimates. For more information about other limitations of the EE-MACC approach see box E2.

E.6 A simple comparison of the energy savings identified in the EE-MACC to the energy savings projected to be delivered through current policy (as set out in the DECC updated energy and emissions projections), suggests that there are areas of cost effective potential that are not being addressed through current policy [Figure E3]. In other areas policy is projected to deliver more than the cost-effective potential identified in the EE-MACC; this is because policies have benefits that have not been quantified, for example the benefits derived from the deployment of technologies that are expensive now, but are likely to be required to meet the UK's long-term carbon targets – in this case, deployment now may reduce the overall costs of meeting those targets through innovation.

E.7 There are also a number of policies included in the baseline (and therefore not in the "projected energy savings from policy" column) that continue to deliver energy savings. In the Industry sector this includes the EU ETS which places a price on carbon and incentivises energy efficiency where it delivers carbon savings. In addition, legacy savings from existing Climate Change Agreements (CCAs) which offer large energy users a discount on the Climate Change Levy in return for energy efficiency improvements, are also included in the baseline. CCAs are estimated to deliver 38TWh over the period from 2012 to 2020[140] Looking at each of the sectors, it is possible to draw some broad conclusions about how policy delivery and the potential identified in the EE-MACC relate.

E.8 **Domestic**: the analysis suggests that it could be cost effective to reduce energy demand in the domestic sector by 56TWh in 2020 and 62TWh in 2025. Policies that reduce energy consumption in the domestic sector are expected to save 55TWh in 2020 and 64TWh in 2025. While there are differences between the technical potential identified in the EE-MACC and policy, overall this suggests that policies are tackling much of the identified cost effective technical potential. Calculations for solid wall are aggregated; as set out in the Green Deal Final Impact Assessment, there is significant cost effective potential within this.

E.9 However, there is the potential for further energy savings through changes in behaviour that are not captured in the EE-MACC, but have been highlighted in annex D. Smart meters will provide the technical means to facilitate a change in energy consumption behaviour, capturing some of this potential. The reduction in energy usage from smart metering is estimated on the basis of the expected behavioural change triggered by the improved provision of energy consumption information. Higher energy savings than assumed in the Smart Meters Impact Assessment are achievable and international trials have found electricity savings of up to 20%[141]. These can be realised through a variety of more sophisticated and targeted measures than assumed in the central case of the smart meter cost benefit

140 These are estimated legacy non traded sector savings over the period 2012 to 2020 for CCA targets set up to 2010. They are relative to a 2008 baseline and it has not been possible to re-estimate these CCA savings against a 2009 baseline. New CCA agreements for targets to be met out to 2020 will be agreed with industrial sectors in December 2012.

141 http://www.aceee.org/sites/default/files/publications/researchreports/b122.pdf

Figure E3: Summary of relationship between potential and policy energy savings in 2020 and 2025 (TWh)

	2020			2025		
Sector	Total potential identified (TWh)	Cost effective potential for energy efficiency (TWh)	Projected energy savings from policy (additional to the baseline) (TWh)	Total potential identified (TWh)	Cost effective potential for energy efficiency (TWh)	Projected energy savings from policy (additional to the baseline) (TWh)
Domestic *Policies included:* CERT (20% extension and uplift), CESP, Green Deal, ECO, Smart Meters, 2010 Building Regulations, Zero Carbon Homes, Warm Front	93	56	55	122	62	64
Commercial (incl. public sector) *Policies included:* Green Deal, 2010 Building Regulations, CRC, Salix, SME Loans, Non-domestic Smart Meters	28	27	21	42	41	30
Industry *Policies included:* Green Deal, CRC, 2010 Building Regulations, SME Loans, Carbon Price Floor (indirect) *Policies in the baseline:* ETS, CCA	42	42	6	45	45	7
Transport as per figure E5. Note – this is consistent with the analysis presented in this annex (which is based on analysis for the Carbon Plan (December 2011)) not the latest DECC energy and emissions projections (October 2012)	66	33	51	133	55	90
Products Policy Policies included: Tranche 1 and 2	38	38	33	41	41	37
TOTAL	268	196	167	383	244	229

Notes: Projected energy savings from policy (except transport) are based on the DECC Updated Emissions Projections, October 2012 and are consistent with the DECC/HM Treasury supplementary guidance values for appraising environment impacts also published in October 2012.

The impact of the carbon price floor is the estimated indirect impact on industry, defined as iron & steel, 'other' industry and commerce and excludes agriculture, public sector and fuel producing industries.

analysis (e.g. home automation, smart thermostats and appliances, comparative energy efficiency advice). It is likely that in order to achieve higher energy savings additional expenditure would be required.

E.10 **Commercial sector** (including non-domestic buildings and the public sector) The analysis suggests that it would be possible to reduce energy demand by 27TWh in 2020 and 41TWh in 2025. While there are some policies that are encouraging energy efficiency investment over and above business as usual improvements (21TWh in 2020 and 30TWh in 2030), our analysis suggests that there is potential for energy savings that are unaddressed by current policy. As set out in Annex C and D the contractual arrangements for managing buildings and behavioural barriers which lead to energy efficiency not being a business priority are likely to be significant barriers to realising energy efficiency in the commercial buildings sector. Developing a stronger understanding of the technical potential for energy efficiency measures in the non-domestic building sector is a priority area: we will be publishing findings of a research project on the mixed and food retail sector in 2013.

E.11 **Industry:** Analysis suggests a significant amount of energy savings are possible across a range of industrial sectors. Whilst the overall potential energy savings presented in Figure E3 are based on a central scenario, the range of potential is wide i.e. from 20-63TWh in 2020 and 28-68TWh in 2025. This range depends on assumptions about the proportion of energy efficiency investment that is taken up in the baseline, which implicitly includes energy efficiency improvements over time. Critical too are assumptions about the extent to which the barriers to the realisation of potential are overcome. For instance, the central scenario presented above takes account of a combination of factors including the availability of technology, replacement life cycles and lead in times for new equipment, physical suitability of sites and hidden costs. It is recognised that the current evidence about potential industrial sector energy efficiency savings is not conclusive given the lack of reliable information about what different technologies can deliver in reality. In addition, there are barriers not included in the analysis that are a real deterrent to take up. These can include supply chain constraints such as the availability of scrap steel for increased recycling in Electric Arc Furnaces. The requirement to reconfigure an entire production process can also deter firms from implementing energy efficiency measures. Annex D provides further detail on the barriers to the uptake of energy efficiency measures.

E.12 In relation to the disparity between policy delivery and the potential identified in the EE-MACC, it is important to note that there is a significant amount of energy efficiency potential that falls outside of the scope of current policies. DECC analysis suggests that 14% of total energy use in the business and public sectors is not covered by current policies (over and above the CCL)[142].

E.13 **Products:** The analysis suggests that the current (and future expected) product standards largely capture the potential for cost effective investment in product standards. This analysis suggests that it may be cost effective to increase the ambition of products standards to the level of the best available technology in lighting and motors, but the additional energy savings would be small. The assessment of the potential for energy savings is based on the assumption that consumers continue to purchase a mix of products with different energy efficiency standards. There could be additional energy savings if there was a change in purchasing patterns to purchase higher efficiency products within the range already on the market.

E.14 **Transport:** the current policy package mainly captures the cost-effective measures for energy savings. Looking to 2025, there may be

142 Based on 2010 energy use and coverage estimates for the CRC, EU ETS and CCA policies. See Figure 5.1 in the Statistical Summary published alongside this document.

Box E2 Limitations of marginal abatement cost curve

Whilst marginal abatement cost analysis is a useful tool it does have a number of limitations and needs to be used appropriately:

- Cost-effectiveness estimates may not reflect non-monetised impacts of abatement opportunities, such as impacts on competitiveness, distributional impacts and on other environmental and social considerations. (for more detail on other potential environmental impacts of measures, see the analytical annex to the Carbon Plan)[143]
- The lack of granularity in the analysis may misrepresent individual increments and measures. For example, some measures which appear in a relatively cost-ineffective block of abatement could be cost-effective (and similarly there may be cost-ineffective instances of a measure contained within a cost-effective block). The order of take-up matters for the attribution of savings to particular measures. This can also significantly change the cost-effectiveness of a measure.
- There may be a substantial difference in technical potential and cost identified in this analysis, and policy costs to deliver this for some measures. For example, negative cost abatement measures identified in this analysis are not always fully taken up without policy and government intervention. This may result in costs increasing substantially.
- MACCs are of limited use in working out where the greatest financial benefits may be made. For example, something very cost-effective that saves a lot of energy each year but only lasts one year may not be as financially beneficial as something that is less cost-effective but delivers small savings for 50 years (unless reinstalled every year).
- MAC curves are limited in portraying the range of uncertainty surrounding abatement potential and cost-effectiveness. The evidence base has significant areas of weakness. There are considerable uncertainties over the development of technologies and their associated costs this far into the future as well as uncertainties around other key factors such as fossil fuel prices. The estimated abatement potential and cost effectiveness presented here are best estimates and are based on assumptions about technology uptake rates and costs that may need to be revised in future.
- Whilst every attempt has been made to be comprehensive in this analysis, some technical options and savings may have been omitted, for example, the potential for energy savings through the shift to cloud computing reducing the need for companies to operate their own servers and instead using more energy efficient servers in high energy efficiency data centres. New services or technologies which may arise from new innovations are also not captured.
- Research has identified that there is significant potential for energy savings through behavioural measures, or optimisation of existing technologies (such as heating/cooling systems) but these are not fully captured in the EE-MACC. We have included the impact of behavioural measures in transport, and as a result of the rollout of Smart Meters. But this is unlikely to fully capture all the opportunities to saving energy through behavioural measures, for example in turning down thermostats or improving energy management in both the domestic and commercial sector.

143 DECC, Carbon Plan, December 2011.

cost effective potential for energy savings through behaviour change – as captured by the sustainable travel measure, but these are likely to be limited in scale. The largest potential for energy savings in transport is delivered through current regulations on new car emissions for 2015 and 2020 which are estimated to save around 56TWh in 2025. There is significant potential to save energy in the future due to the superior energy efficiency of ultra-low emission vehicles over conventional internal combustion engines. While moving to ultra-low emission vehicles may be relatively expensive in the short term, we expect costs to come down over time as production increases.

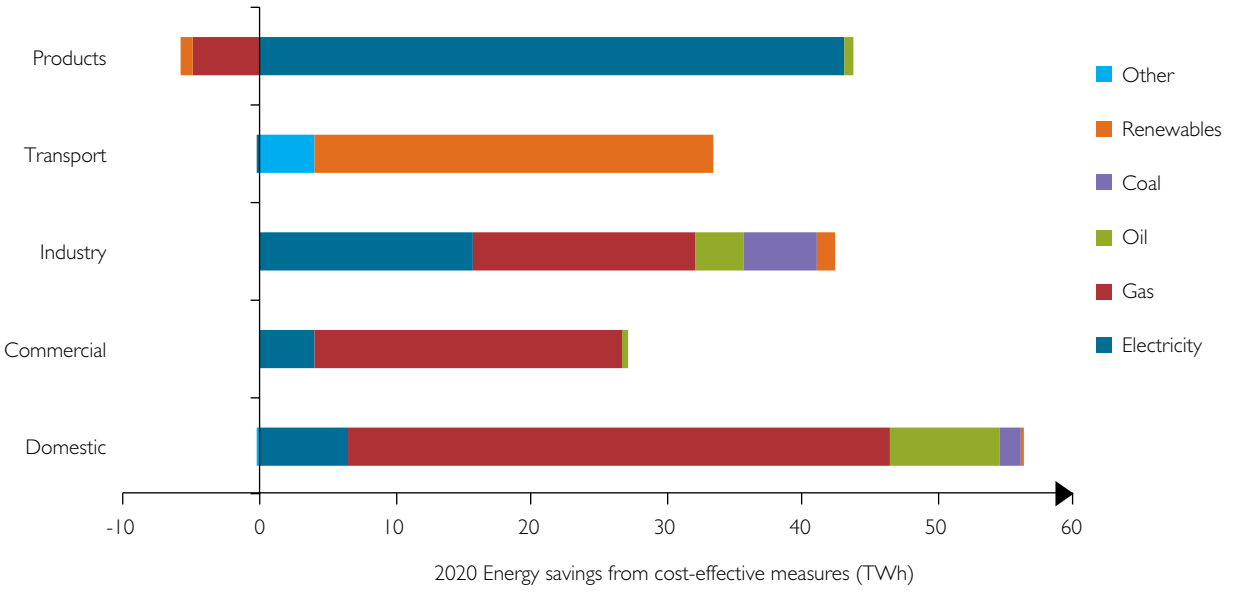
Impact on fuel demand

E.15 Overall the net impact of realising the cost-effective potential identified in the EE-MACC would be a reduction in electricity demand of 69TWh and 74TWh gas and 53 TWh of oil, coal, renewables and other fuels (mainly petrol and diesel in the transport sector) as shown in figure E4. The picture is similar for 2025 although there are significantly greater potential savings in other fuels and gas than estimated for 2020. Some energy efficiency measures increase consumption of some fuels, for example improving the energy efficiency of products increases gas demand as more efficient electrical appliances produce less heat. However, overall there is a reduction in energy demand as a result of fuel switching.

Comparison to analysis undertaken with McKinsey & Co on the potential for reductions in electricity demand

E.16 The initial assessment of the potential around electricity demand reduction drew on the analysis on the potential for reductions in electricity demand undertaken with McKinsey & Co using their Global Abatement Cost Curve methodology[144]. There are differences in the methodology between the EE-MACC and the McKinsey approach which means that findings are not directly comparable. But it also concluded that there was significant technical potential to make efficiency savings beyond those incentivised by existing policy.

Figure E4: Impact of demand for individual fuels by sector in 2020



144 http://www.decc.gov.uk/en/content/cms/emissions/edr/edr.aspx

The Evidence Base for the EE-MACC

E.17 The data for the EE-MACC has been collected from a number of different sources, but as far as possible has been appraised on a consistent basis. Some of the models overlap in their assessment of the energy efficiency potential, and realisation of some of the potential in some models will reduce the potential for energy savings through another technology (for example insulating a building reduces the energy savings delivered through heat pumps). We have removed overlaps, to the extent to which they were identified, on the basis of a priority ordering that takes into account the cost-effectiveness of the measure and the timing of roll-out of policy implementing it. Existing policy measures have been prioritised using the merit order used for the DECC energy projections.

E.18 For the new measures we have put smart meters at the top of the merit order, as a highly cost effective means to deliver behaviour change. The energy saving from installing heat pumps measures are also reduced to take into account the reduction in heat demand as a result of insulation. Measures within the industrial sector have been adjusted to account for overlaps within the different models. The transport measures have been ordered based on the certainty associated with the measures (both in terms of implementation and impact) at the time of modelling.

E.19 We have estimated the potential for energy efficiency in specific areas based on assumptions for fulfilling the technical potential identified. These assumptions are not targets for future delivery, but indications of what could be possible. The details of the evidence base and key assumptions for each area is set out below:

E.20 **Non-domestic retrofit of energy efficiency measures:** The scale of abatement potential from measures is estimated using data from the National Non-Domestic Buildings Energy and Emissions Model (N-DEEM). N-DEEM was developed by the Building Research Establishment to provide an insight into energy use and abatement potential within the country's non-domestic properties. Technology penetration rates estimated by Element Energy[145] are used to estimated the remaining potential over time. The N-DEEM project ran between the mid-1990s to mid-2000s. Estimates of consumption have been updated within the past two years, based on a range of market reports on technology uptake. We have made the simplified assumption that all the technical potential has been installed by 2030.

E.21 **Domestic retrofit insulation:** The housing stock and estimates of energy savings and costs of installation are consistent with the Green Deal Final Impact Assessment (IA)[146]. In assessing the impact of insulation on energy consumption and greenhouse gas emissions we have taken into account a direct rebound effect of 15% to reflect comfort taking. The impacts of policy on the remaining technical potential for the insulation of lofts and cavities are consistent with the Green Deal Final IA in 2020. For the purposes of calculating technical potential in 2025, we have made the simplified assumption that any remaining cavities and lofts are fully insulated by 2025, thereby reducing the technical potential to zero for these measures. We have also made the simplified assumption that all solid walls could be insulated by end 2030. In practice, we would expect a mix of different energy saving measures to be installed in this time, since it will be most cost-effective and appealing to households to make changes alongside other building works to minimise hassle. Energy savings could be increased through other measures, such as draught proofing and floor insulation.

145 Element Energy – *Uptake of Energy Efficiency in Buildings* – 2009. http://downloads.theccc.org.uk/docs/Element%20Energy_final_efficiency_buildings.pdf

146 DECC, Green Deal and ECO Final Impact Assessment, June 2012

E.22 **Heat pumps:** Heat pumps have been included as an energy efficiency measure. We have assumed that heat pumps are installed so that the high level of ambition for heat set out in the Carbon plan is achieved by 2030. This suggests up to 165TWh of heat from low carbon technologies (including heat pumps) by 2030. The assumptions on the costs of installing heat pumps, and energy savings generated are consistent with modelling for the Carbon Plan which was derived from the Heat model developed for the Committee on Climate Change[147].

E.23 **CHP:** We have assumed that greater deployment of combined heat and power could lead to savings in gas used for heating, leaving electricity demand unchanged. We have only estimated the CHP potential in the commercial sector, as the potential for CHP in the industrial sector is captured within the industrial analysis. The analysis is based on ambitious but achievable assumptions about the potential to use CHP in non-domestic buildings taken from analysis commissioned by AEA Technology.

E.24 **New build:** The estimates for the potential to go further in new build are based on the analysis carried out for the consultation on increasing the requirements of Part L of the Building Regulations launched on 31 January 2012[148]. For the purposes of this modelling the estimate has been based on an 8% tightening of the carbon compliance level for new homes over 2010 Part L and an 11% tightening over 2010 Part L for new non-domestic buildings. The latter is based on modelling for the notional building option at consultation which did not include building integrated renewables. The impact of tighter standards for new windows and extensions has also been included. However, no final decision on the 2013 changes has yet been taken. Consultation responses are being considered and an announcement will be made in due course.

E.25 **Smart Meters:** the MACC presents the central cost and savings assumptions as applied in the smart meter impact assessment[149]. To improve comparability with other measures presented here financing costs have been removed and expenditure is considered in cash flow terms (i.e.as it will occur during the rollout) and also uses the latest released version of DECC's Updated Energy and Emissions Projections[150].

E.26 **Products:** The Products Policy energy savings estimates draw on a wide range of empirical data including present and historic data on the stock of products, product sales, energy efficiency of products, product lifespan, and usage. Data on energy efficiency is commonly taken from existing market research as well as manufacturers' literature. An 's-shaped' take-up curve of purchases of more efficient products is assumed up until 2020. The savings from Products Policy are more uncertain over later years as it becomes less clear whether policies drive efficiency improvements or whether this would have been driven regardless by forecast increases in energy prices, or consumers' future preferences for better products. For this reason, a taper is applied to the savings beyond 2020.

E.27 The savings from Products Policy are net of a heat replacement effect (HRE). HRE occurs where improved efficiency results in a reduction in the amount of useful space heating from products, resulting in an increase in the use of heating systems. The direct rebound effect has not been modelled, with the exception of boilers (here the comfort taking effect has been modelled, whereby the energy saved from more efficient heating results in boilers being used more

147 NERA consulting and AEA, Decarbonising Heat:Low-Carbon Heat Scenarios for the 2020s, June 2010 http://downloads.theccc.org.uk.s3.amazonaws.com/4th%20Budget/fourthbudget_supporting_research_NERA-AEA_Decarbonising_heat.pdf

148 http://www.communities.gov.uk/publications/planningandbuilding/brconsultationsection2

149 http://www.decc.gov.uk/en/content/cms/consultations/cons_smip/cons_smip.aspx

150 DECC, Updated Energy and Emissions Projections 2012,October 2012.

often). It is likely that the size of the direct rebound effect in changing patterns of usage in other energy using products is likely to be small. In order to realise savings associated with Products Policy, upfront financial costs are incurred to purchase the more efficient products.

E.28 In addition to the savings outlined above for a first tranche of measures (already implemented across the EU), and a second tranche of measures (part way through implementation), there is scope to go further through Best Available Technologies. This analysis covers those measures that are deemed to be available either now or will be available by the end of the 2020s. Estimated costs of moving to the most efficient technologies have been collated from industry information. This is subject to significant uncertainty, so costs have been estimated at the high end. We have also removed overlaps with other policies.

E.29 **Industry:** The evidence on the potential for energy efficiency in industry relates to industrial processes and is presented by sector, not technology. It is derived from three principal sources that together provide the potential set out in the EE-MACC:

- The Energy End-Use Simulation Model (ENUSIM) is a technology based, bottom-up industrial energy end-use simulation model which projects the uptake of energy-saving and/or fuel-switching technologies taking into account the cost effectiveness of technology options under future carbon and fossil fuel prices scenarios[151].
- Further detail on future abatement potential has been derived from work undertaken by AEA Technology[152]. The major sources of abatement covered within this work focus on six major sectors: cement, refineries, glass, chemicals, food and drink, and iron and steel.
- DECC commissioned further analysis to assess abatement potential beyond that considered in the AEA work[153]. This project is based on top-down energy and abatement projections for 17 wider groups of light manufacturing.

E.30 **Transport:** The analysis of transport measures is consistent with that published in the Carbon Plan (December 2011). Transport measures considered as contributing towards Carbon Budgets 1-3 and measures included in the most ambitious scenario for contributing to Carbon Budget 4 that have the potential to improve energy efficiency are included in the EE- MACC and are listed in Figure E5. The marginal impact of each measure is considered based on the ordering shown in Figure E5 and starting with Carbon Budget 1-3 measures. Although biofuels are not included as an energy efficiency measure, the results are affected by assumptions on biofuel penetration in the modelling.

E.31 The Department for Transport's National Transport Model (NTM) has been used to assess the energy savings that the road transport measures could deliver; with off-model adjustments made to reflect the impact of an illustrative technology mix of plug-in vehicles. The NTM also provides the changes in vehicle kilometres driven, CO_2 emissions, air quality and congestion associated with the measures that are used in the cost-benefit analysis of the measures.

151 Industrial Energy End-Use Simulation Model ENUSIM. DATABASE, DECC. (Updated: March 2010 and September 2002 [Original Version: March 2001] Entec UK Limited and Cambridge Econometrics).

152 Analysing the Opportunities for Abatement in Major Emitting Industrial Sectors. Report for The Committee on Climate Change AEAT/ENV/R/Industrial Energy Efficiency ED56369 Issue Number 1, 8th December 2010.

153 Understanding the Industrial Sector Abatement Opportunities for the 4th Carbon Budget Carbon Abatement Potential within the 'Tail End' Industries . Report for DECC. Arup. Ref: 81/11/2010 – Issue June 2011.

Figure E5: Transport measures

Carbon Budget 1-3 policies	Potential Carbon Budget 4 policies
EU new car CO_2 regulation: midterm target Average EU new car emissions reach 130gCO_2/km in 2015 and remain constant to 2030	**Average new car emissions 50gCO_2/km in 2030** Illustrative technology mix: conventional vehicles 80g in 2030; 50% of new car sales plug in vehicles in 2030
EU new car CO_2 regulation: 2020 target Average EU new car emissions reach 95gCO_2/km in 2020 and remain constant to 2030	**Average new van emissions 75 CO_2/km in 2030** Illustrative technology mix: conventional vehicles 120g in 2030; 50% of new van sales plug in vehicles in 2030
Potential EU new van regulation Average EU new van emissions fall to 147gCO_2/km in 2020 and remain constant to 2030	**Extension of HGV efficiency measures** Increased impact of industry led action to improve fuel efficiency
Complementary measures for cars Various measures which improve average new car emissions are taken up by 2020 and continue to be fitted to 2030	**Sustainable travel measures** Increased impact of sustainable travel measures in 2020s – up to a 6% reduction in car trips in urban areas
Low rolling resistance tyres for HGVs Improvements in low rolling resistance tyres for HGVs are made through to 2030	**Further rail electrification** Electrification of Midland Mainline and Welsh Valleys (now committed policy)
HGV efficiency measures Take up of various HGV technologies and efficiency measure including eco-driving for HGV drivers	
Local sustainable travel fund (LSTF) Allocation of funding from LSTF for behavioural measures to reduce car trips	
Low carbon emission buses Increasing uptake of hybrid buses up to 2020 and beyond	
Rail electrification Electrification of Great Western Main Line & North West lines	

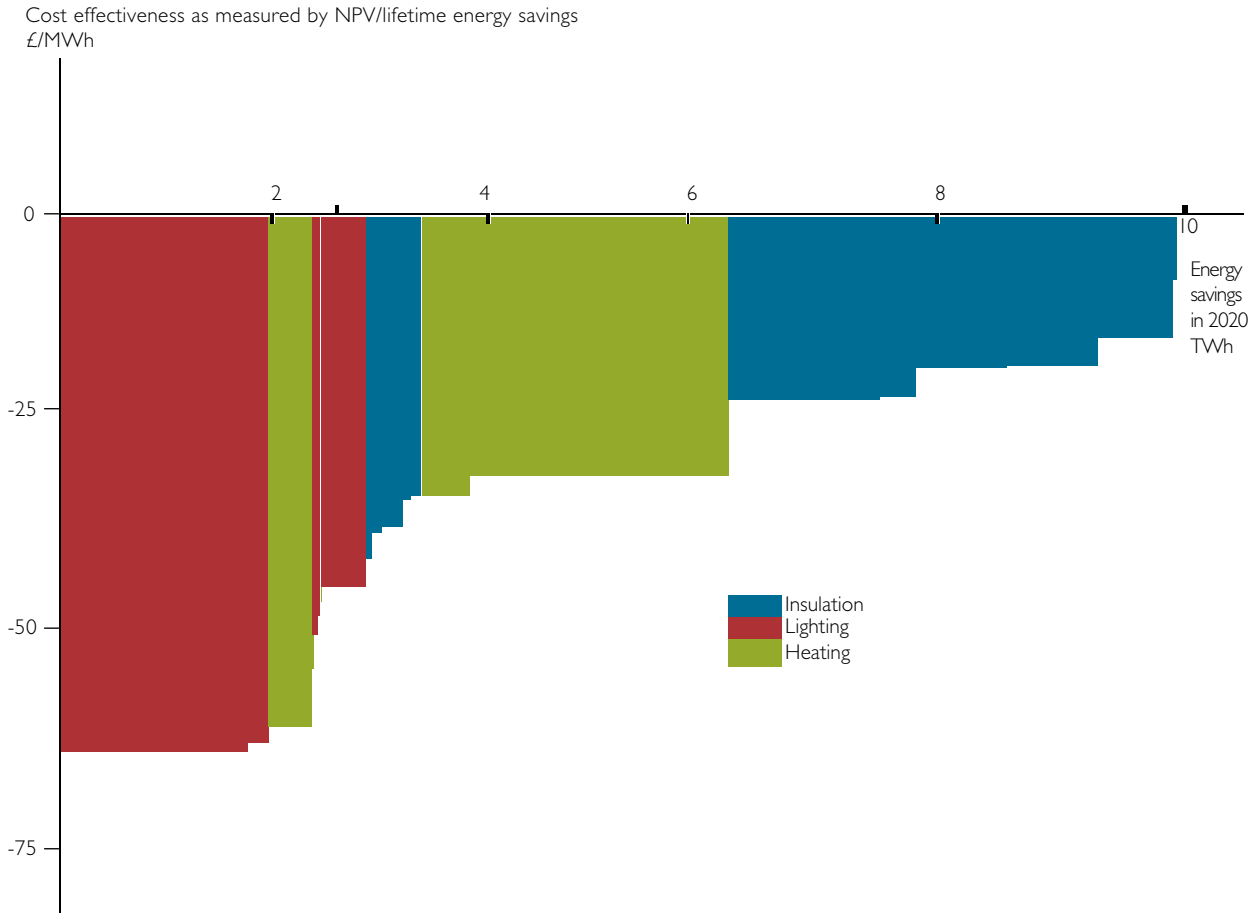
Alternative perspectives

E.32 The EE-MACC is based on the social perspective and identifies the potential for cost-effective investment on the basis of the social costs and benefits. However, for an individual decision maker the costs and benefits will be based on the private costs and benefits. Where the benefits of a measure mainly accrue to society, for example through their environmental impact, then it may not be cost effective for the individual to take up the measure. This is one of the significant reasons why apparently cost effective investment potential is not taken up.

E.33 The private perspective means that the benefits of energy efficiency are based on the higher retail price paid by the consumer, instead of the estimate of the resource cost of energy used for the social analysis. But the value of environmental externalities, such as carbon emissions are not included. The private perspective also includes a higher discount rate (7%) to reflect the higher borrowing costs.

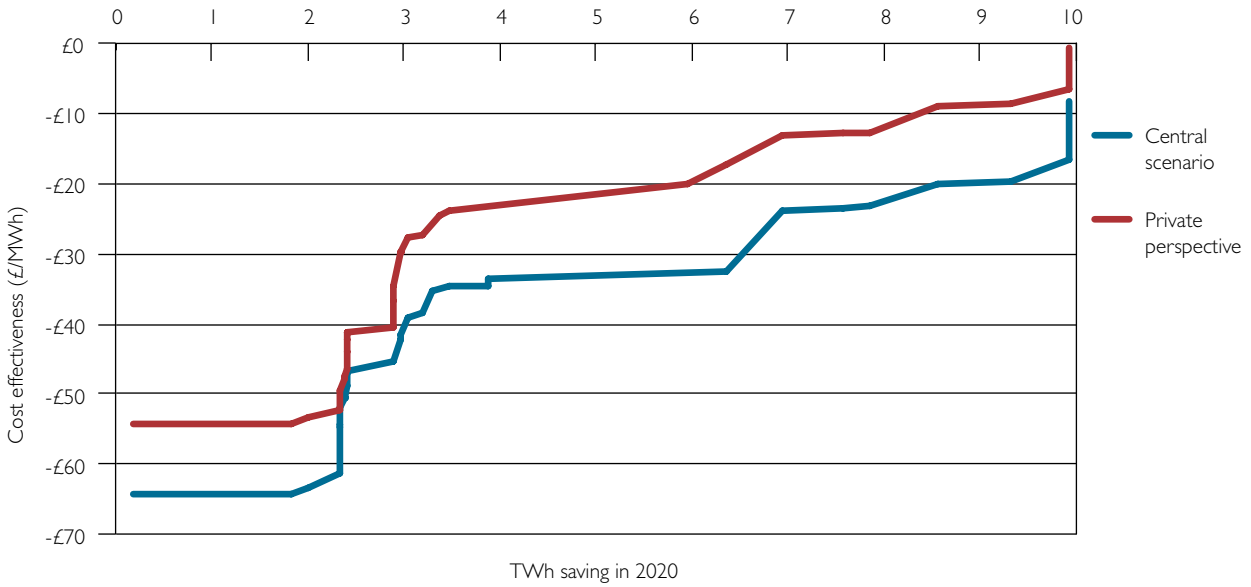
E.34 While it is not possible to estimate the private cost benefit analysis for all measures included in the EE-MACC, the chart below sets out a private cost benefit analysis for the non-domestic building sector. Figure E6 show the energy efficiency MACC for this sector and figure E7 illustrates how the shape of the MACC changes when viewed from a private perspective. It shows that although the potential energy savings in the sectors are less cost effective when considered from a private

Figure E6: 2020 Energy Efficiency Marginal Abatement Cost Curve for non-domestic retrofit[154]



154 Potential for energy savings larger than in figure E3 as overlaps have not been taken into account. The cost-effectiveness of individuals measures have been estimates using the same methodolgy and assumptions as the overall EE-MACC.

Figure E7: comparison of the profile of the 2020 non-domestic retrofit MACC depending on whether it is the social or private perspective



investor's perspective, there remain considerable opportunities for cost effective energy efficiency investments.

Sensitivity analysis

E.35 There is considerable uncertainty around the key assumptions that have been used to produce the EE-MACC and the results are sensitive to a range of factors which are hard to predict. Sensitivity analysis has been used to test the impact of changes in the key input assumptions (energy savings, energy prices and capital costs) on the MACC curve for the non-domestic building sector in figure E6. The sensitivity analysis focuses on the impact of changes in these input assumptions on the cost effectiveness of the potential energy savings. In reality we would expect these changes to affect the take up of energy efficiency measures in the business as usual scenario, which would affect the total remaining potential. It is not possible to infer the impact of these sensitivities on the overall EE-MACC, but it gives an indication of the potential range of impacts, and how the different sensitivities can affect cost-effectiveness.

E.36 The figures below show how the outline of the non-domestic buildings sector MACC changes under different input assumptions. Figure E8 show the impact on the non-domestic buildings sector MACC of a 10% reduction in energy savings as a result of behaviour change reducing underlying energy demand. This reduced both the potential savings available and the cost effectiveness of these savings. However, the savings identified remain cost effective from a societal perspective. Figures E9 and E10 show the impact on the shape of the MACC of changes to the capital costs and energy price assumptions. The high and low costs scenarios are based on the capital costs being 50% higher or lower than in the central estimate. The energy price scenarios are based on the standard government appraisal guidance and are roughly equivalent to energy prices being 9% lower or 8% higher on average over the period. The comparison of the scenarios illustrates that, while even large changes in the capital cost of delivering measures has a limited impact of the potential savings, changes in energy prices have a much more significant impact.

Figure E8: sensitivity analysis for lowering energy savings from non-domestic retrofit measures in 2020

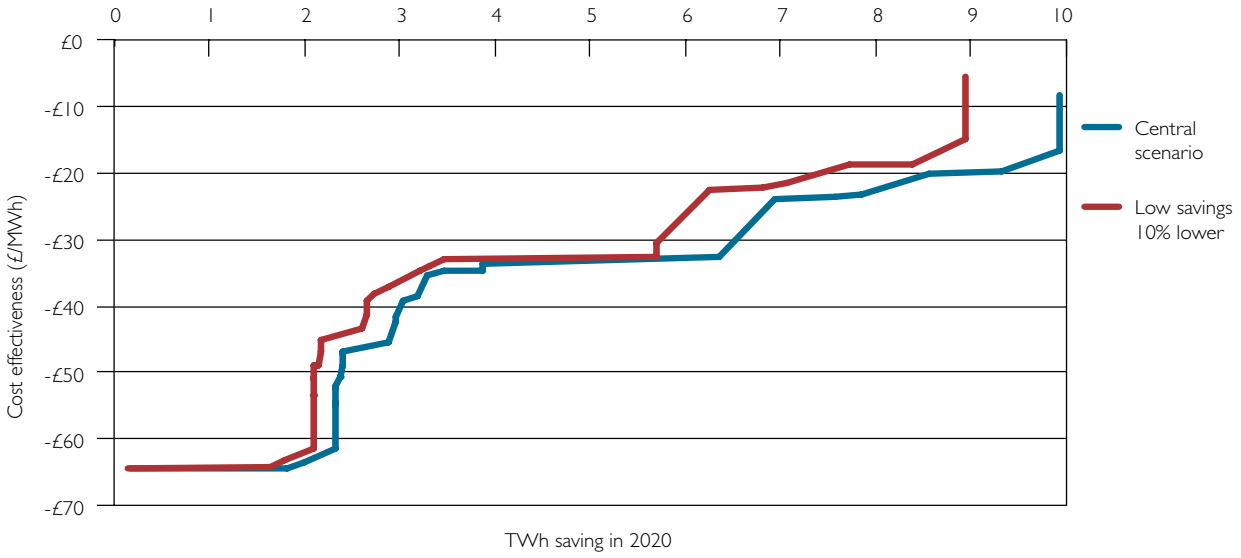


Figure E9: sensitivity analysis for changing capital costs for non-domestic retrofit measures in 2020

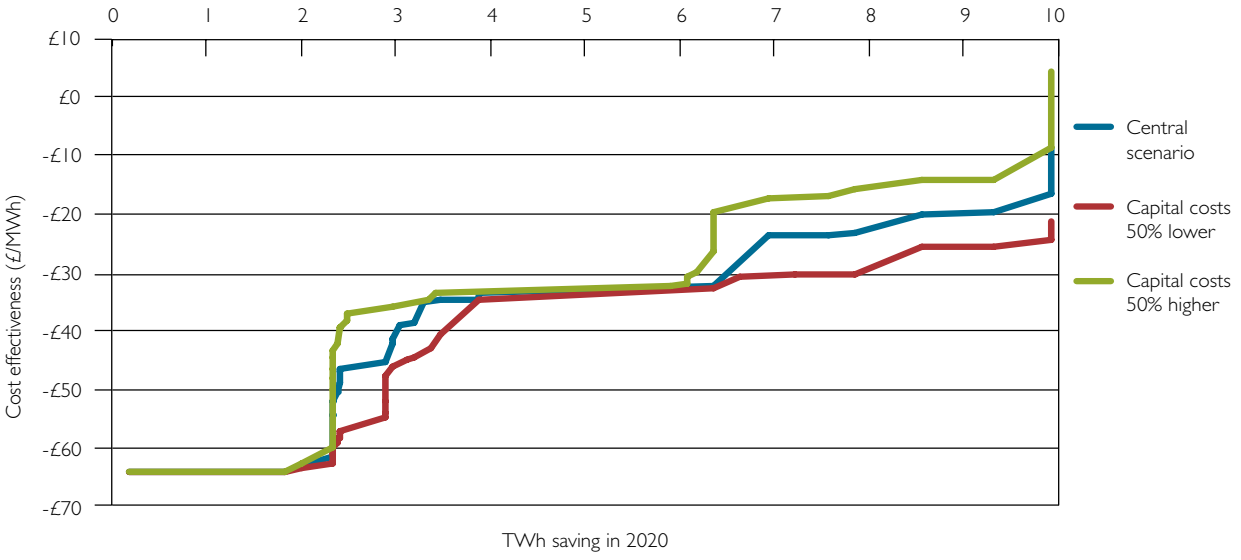
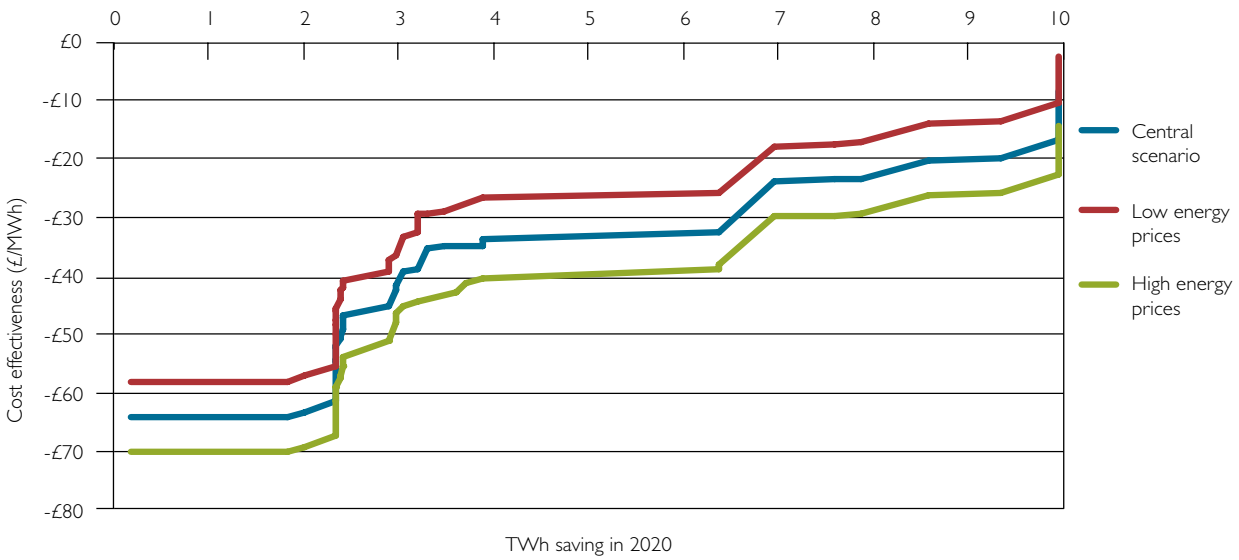


Figure E10: sensitivity analysis for changing fuel price assumptions for non-domestic retrofit measures in 2020



Annex F: Call for Evidence summary of responses

F.1 On 8 February 2012 DECC published an Energy Efficiency Call for Evidence alongside the formal launch of the Energy Efficiency Deployment Office. This annex summarises those views received against the a)-h) questions asked. Where not confidential, the responses received have been published on the DECC website.

Summary points:

- The vast majority of responses were supportive of EEDO's creation, remit and the forthcoming Energy Efficiency Strategy. Many responses indicated willingness to follow up with individual meetings, or provide further information.
- All responses that considered energy efficiency potential in the UK agreed that there was significant room to improve on this agenda. However, responses disagreed over the sector where there was the most potential. The majority suggested the domestic sector.
- In the services sector, there was some support for commercial Display Energy Certificates (DECs), as well as finding ways to stimulate of the ESCO market.
- Many responses, particularly those from ESCOs and the business community asked for greater policy certainty to provide a realistic investment framework for the long-term future.
- In terms of innovation, CHP and district heating were commonly cited examples where there is room for further support. It was often cited that a further financial incentive may be needed to drive demand.
- The prospect of tapping into UK Green Investment Bank (GIB) funding was welcomed by many respondents. Some suggested that it could be modelled along the lines of the KfW in Germany.

a) Where would you prioritise further Government focus and why?

F.2 Many responses were very supportive of the concept of EEDO and its remit. In particular, the joining up current policy to make it work in a more coherent way, supporting greater innovation in energy efficiency, developing behavioural research and messaging, and tightening and harmonising energy efficiency standards.

F.3 Several large themes emerged from the responses. Principal among these was that the energy efficiency policy framework has to provide long-term stability and certainty for investors and business to properly engage with the energy efficiency market. Several responses also advocated that the public sector should take the lead on energy efficiency, testing and demonstrating technology and finance models, as well as improving our

procurement processes. Other responses suggested a greater role for decentralised energy and waste heat recycling.

F.4 Responses also suggested other ideas, including mandating energy efficiency improvements in the social housing sector and a greater role for advanced heating controls.

How large is the potential for further energy efficiency gains?

F.5 Those responses that commented on potential all argued that it was significant in several areas, including the domestic, commercial and industrial sectors. A common position was that cavity and loft insulation still had potential, and should be tackled before solid wall insulation.

Which specific technologies and behavioural measures have the greatest unrealised potential?

F.6 On heating, it was argued that advanced heating controls had great unrealised potential, and should be supported through future policy. Other responses advocated combined heat and power (CHP) and the wider use of heat networks in order to minimise distribution losses.

F.7 Technology manufacturers provided evidence for their technologies. Examples include voltage optimisation and LEDs. It was also argued that, in some cases, installing microgeneration technology could lead to increased awareness of energy use, and therefore drive overall demand reduction.

F.8 hat are the costs and other constraints on realising that potential?

F.9 Responses identified three main groups of barriers to realising energy efficiency potential. First, financial barriers such as upfront capital costs, long payback periods and transaction costs, could make energy efficiency measures appear too costly an investment for businesses or householders requiring faster payback. Second, behavioural and informational barriers could prevent consumers from fully appreciating the benefits of energy efficiency. Third, planning constraints posed a barrier to increased take-up of energy efficiency measures where they affect the external appearance of a building.

b) Within the context of the existing and forthcoming UK policy framework, what lessons do you think we can learn from other countries to help us further overcome these barriers?

F.10 Many responses referenced the German KfW as a model that could be followed by the GIB. These comments assume the UK would be in a position to copy Germany's subsidised interest rate and tax break model. Another example from Germany cited the use revenue from energy taxes to support cost effective measures and R&D.

F.11 From 1992, Denmark has implemented a carbon dioxide tax of around $14 for business and $7 for households, per tonne of CO2 while offering a tax refund for energy efficiency modifications.

F.12 Two Australian domestic policies were of note: first, a scheme offered a substantial monetary rebate to customers to generate interest in insulation. Second, a the roll out of large domestic retrofitting programmes that included both energy and water efficiency, leading to significant and cost-effective energy and water savings.

c) Can you provide examples of barriers to further uptake of third party finance solutions and examples of third party finance solutions, internationally or in the UK, that overcome the barriers to further uptake?

F.13 Feedback from ESCOs and the supply chain suggested that capital from banks and other lenders was available to larger companies. However, it was often the case that, given the economic situation, the client company did not want to take that loan onto their balance sheet. Finance for smaller businesses was potentially less available due to uncertainty as to the businesses lifetime (i.e. would the business be around long enough for the loan to payback?).

F.14 A number of trade associations confirmed that they had used third party financing for projects mostly relating to CHP installation. They considered that if GIB money could be provided at 'better than commercial' rates, this could be very important in realising energy efficiency potential at the margin. One non-profit organisation supported the principles of the Electricity Demand Reduction project under Electricity Market Reform, noting that the demand side should be able to compete with the supply side.

F.15 There was support for increasing the role of ESCOs in the UK market and it was noted that part of this would be about building trust in the ESCO model. Some ESCOs noted that working with the public sector in the UK was a particular challenge and pointed to the US model, where Energy Performance Contracts were standard. In the UK, public sector procurement was a significant barrier given that the cost of any up front assessment of energy efficiency potential would be lost if the contract was not subsequently secured. Was there a way of getting just one independent to do the original assessment and then for others to bid?

F.16 One county council noted the downsides of third party contracting, including the potential for complicated disputes, but others provided examples of where they ewer helping local businesses and organisation aggregate projects. This had the potential to lead to more cost-effective energy efficiency supported by good size investment.

F.17 Germany was used as an international exemplar for investment, particularly by those advocating the whole house approach. See the KfW example noted above. One noted approach taken by the EU Bank of Reconstruction.

F.18 A number of those who responded noted the potential impact of political risk to investment, requesting a stable regulatory environment.

d) Of what empirical evidence are you aware that looks at the effectiveness of specific interventions relating to energy behaviours in the domestic and non-domestic sectors?

F.19 Of the 43 responses that answered the question, 26 suggested sources of evidence which might be of use to EEDO.

F.20 Most of this evidence related to the domestic, rather than the non-domestic side. Although we are already aware of many of the high-profile studies suggested by respondents, such as the OPower evaluations and ACEEE research reports, there are a number of smaller studies that we were not aware of. For example the British Gas research on their Green Streets initiative.

F.21 Of those respondents who did not provide any empirical evidence, a number discussed the general effectiveness of their particular products, including smart heating controls and phase change materials.

e) Have you been involved in, or are you aware of, any case studies where energy efficiency benefits have been realised and effectively measured?

F.22 Many case studies were product specific. A number of responses discussed small scale domestic case studies. These included the installation of innovative or multiple energy efficiency measures installed in samples of new build and retrofitted homes. The homes' energy use were monitored rigorously and results analysed.

F.23 In industry, case studies focused on attempts to reduce the energy intensity of the biggest energy consumers through the optimisation of processes. In less energy intensive industries, more straightforward efficiency measures were adopted.

F.24 In the services sector, there were examples of specific cases in which energy efficiency measures have been very effective. These included several responses covering public sector buildings. There were fewer responses covering the energy use of private sector uses.

F.25 One more general point of interest that applied across sectors was the attention given to achieved savings rather than to predicted savings (often there was an appreciable gap between the two). Measurement of the benefits was in some cases direct (through monitoring instruments) but more often modelled, referenced from other studies, or not quantified.

What were the benefits of these projects and what were the costs, including those of monitoring?

F.26 A wide range of benefits had been identified for households/organisations becoming more energy efficient. Predictably, these include: energy and carbon saving; financial savings; job creation and economic growth. Less expected responses also include the health and psychological benefits of improving energy efficiency, and improving the value of properties. However, few of the projects were able to quantify the energy efficiency benefits directly.

F.27 Several projects included a detailed discussion of the capital costs of these measures and the payback periods. For some of the more visionary proof of concept projects many of the measures installed were shown not to be cost effective.

F.28 Even fewer projects covered the costs of monitoring energy use. Those that did noted that equipment was expensive and it was time consuming to install it, limiting the number of properties that can be rigged up for monitoring.

F.29 Certain organisations offered to discuss case studies in depth or share case studies when they became available. These also contained some policy recommendations and points of interest, including: that water and energy are not sufficiently metered or sub-metered; that the rates charged by energy companies are financially disadvantageous to low-usage customers; finally that there may be a good case for increasing public support for industrial energy efficiency R&D, particularly demonstration.

f) Do you have any concrete examples where more efficient processes such as these are saving energy and money?

F.30 Support for two specific technologies was advocated. First, CHP is a mainstream technology that has been used by industry for over 20 years. CHP is about 80% efficiency at converting energy into heat and power, less than electricity efficiency but greater overall. Support for micro-CHP for households from SSE where it is a viable option for electricity generation. It was not directly brought through by the evidence but as heat markets develop, CHP becomes more viable as the amount of waste reduces.

F.31 Second, there was support from for waste heat recovery; an emerging technology that UKERC estimates could save 10-20 TWh per year. NSG group suggested this could be up to 15% of downstream energy. The options for reusing heat included fulfilling an on-site heat demand, conversion to power, and transport to an off-site user; whether this be another industrial site, a public building or a district heating scheme. This process would not benefit all sectors as some (for example cement) already use waste heat for drying.

What if anything should DECC do to incentivise such process efficiency?

F.32 All examples given involve the provision of financial incentives. For example, the Boiler Scrappage scheme was cited as an effective tool in driving improvements in process efficiency. It was also thought that Government should provide industry with low cost finance to fund energy efficiency investment. Government could also guarantee an incentive for biogas by fixing long term fuel duty such that it is financially attractive. There is a barrier when CHP LEC is withdrawn and suggestion that a FiT could cover CHP.

g) What else should DECC do to deliver permanent, additional reductions in UK electricity demand to enable cost-effective achievement of carbon targets? Why should DECC do this?

F.33 Although it was difficult to pick themes from the answers to this question, some responses were repeated number of times. There were several instances of industrial users urging additional support for the development of on-site renewable/off grid generation technologies.

F.34 A small number of respondents were really against developing policies on just electricity, thinking that a more holistic approach, with gas and other fuels included would be preferable. There were several calls for stronger action at an EU level on appliances and tougher requirements for new and refurbished buildings.

F.35 One interesting idea was that options for promoting efficiency schemes using work-based solutions similar to the cycle-to-work and childcare vouchers schemes. A small number of respondents (energy management and efficiency suppliers) were in favour of the government offering more direct support to incentivise electricity reduction.

h) What methods might be used to achieve this?

F.36 Several respondents felt that existing methods of establishing baselines and conducting measurement and verification (M&V) could be adopted. Particular mentions were given to IMPVP and ISO 50001 standards. There were several responses which were dismissive of the idea of a market based mechanism, some particularly citing the already crowded policy landscape as a reason.

Other responses

F.37 Responses falling outside the specific Call for Evidence questions varied substantially. It was, however, possible to identify themes:

F.38 First, a number of responses advised that we should be careful about language use and definitions in the strategy. For example, we should refer to 'fuel saving' rather than 'energy saving'. We should also keep the distinction between energy efficiency and demand reduction strong throughout the strategy.

F.39 Second, on policy design, responses suggested that choice editing could be used to minimise the effect of individual irrationality. Policies that provided both a carrot and stick, such as the arrangement between CCL and CCAs was applauded. Several respondents were against the levying of policy costs onto consumer bills owing to their regressive effects. Further, we could consider improving water efficiency, given the relationship between using energy and heating water.

F.40 Third, the government could take the lead in a similar way to the Australian government. There, the government only rents buildings that comply with stringent energy efficiency standards.

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