Making business sense
of climate change

HM TREASURY

CARBON TRUST

defra
Department for Environment Food and Rural Affairs

energy saving trust™

Energy Efficiency Innovation Review: Summary Report

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1 INTRODUCTION

BACKGROUND TO STUDY

1.1 At the Pre-Budget Report 2004 Defra and HM Treasury jointly launched an Energy Efficiency Innovation Review (EEIR). The purpose of the review was to examine how a step-change in energy efficiency in the domestic, business and public sectors in the UK could be delivered cost effectively and how energy efficiency improvement could be embedded into decision making across the economy. The review was carried out under the leadership of a Steering Group drawn from the two sponsor Departments, the Carbon Trust and the Energy Saving Trust (EST) and was designed to be an important input to the wider review of the UK Climate Change Programme (CCP).

1.2 For the purposes of this review, the word "innovation" is used in a broad sense to mean not only technological but policy innovation. Given the potential wide remit of energy efficiency, this review has focussed on how to deliver demand side efficiencies, how to increase the uptake of existing energy-efficient goods and services and how to accelerate the development of new, energy-efficient technologies. It does not cover transport or energy services, nor does it explore the scope for local and regional delivery – work which is being pursued through other studies as part of the CCP. The assessments of potential energy and carbon savings from the proposed policies are projected to 2010 (medium term) and 2020 (longer term). The role of new technologies up to 2050 is also considered.

OUTPUTS FROM THE REVIEW

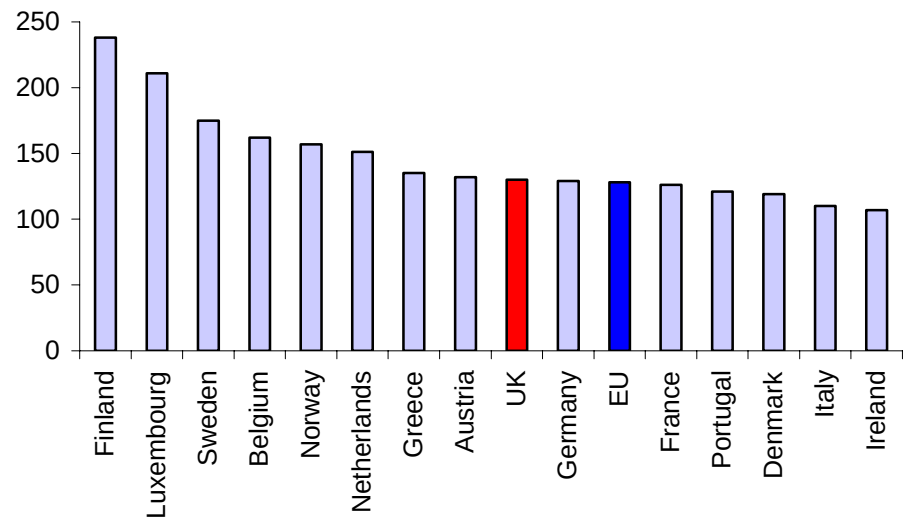
1.3 This document summarises the principal conclusions of the review. These are presented in greater depth in the main reports, which have been published as independent reports to Government by the Carbon Trust and the Energy Saving Trust. The review was informed by a number of supporting studies, detailed at Annex 1, which will be published shortly. A number of recommendations from the review have already fed into the wider review of the UK Climate Change Programme. The Government will respond to the EEIR both in the CCP and through later policy processes such as the Energy Review and the Comprehensive Spending Review 2007.

THE INTERNATIONAL CONTEXT

The UK's position in a global landscape – energy intensity

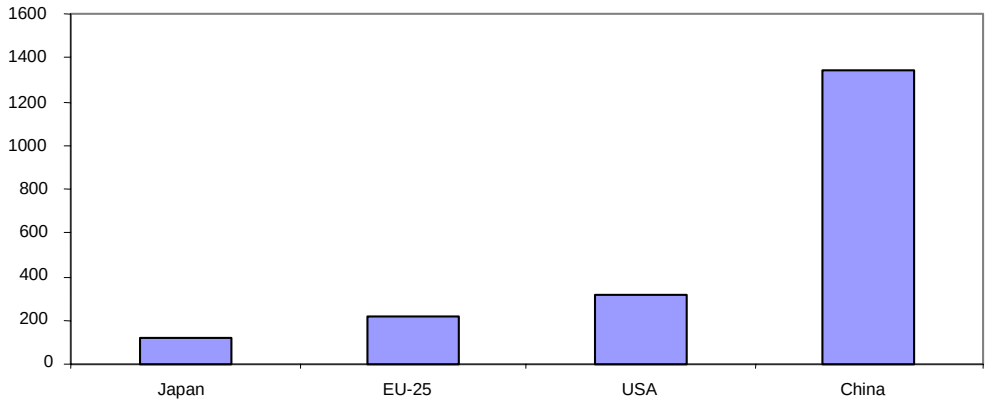
1.4 At a global scale, measures of energy consumption per unit of GDP (energy intensity) provide a basis for international comparisons of energy efficiency performance. Such measures indicate that the UK is a mid-range performer within the EU while the EU, together with Japan and Switzerland, are the best performers internationally in terms of energy intensity. In line with other countries within this group, UK energy intensity is improving and there seem to be no major areas of energy consumption where the UK has performed notably worse than the EU average over the period 1990-2002.

Figure 1: Energy intensity of EU countries in 2003 (in tonnes of oil equivalent/million EUR GDP at 1995 market prices)



Source: Enerdata (calculations based on Eurostat data). Taken from European Commission Green Paper (2005), *Doing More with Less – Green Paper on Energy Efficiency*

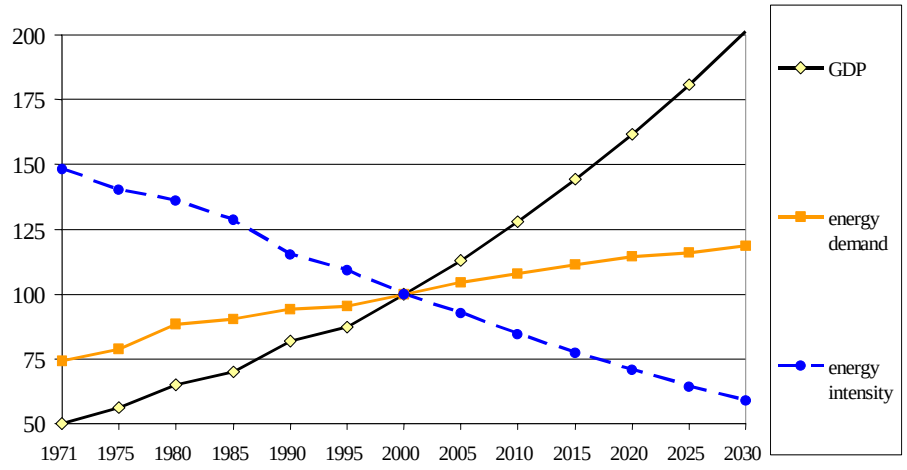
Figure 2: Energy intensity of EU, Japan, USA and China in 2003 (in tonnes of oil equivalent/million EUR GDP at 1995 market prices)



Source: Enerdata (calculations based on Eurostat data). Taken from European Commission Green Paper (2005), *Doing More with Less – Green Paper on Energy Efficiency*

1.5 Despite general worldwide improvements in energy intensity, no country, either within the EU or elsewhere, has yet achieved a sustained combination of GDP growth and falling total energy consumption. The very best that has been achieved so far (in some EU countries) is a combination of relatively modest GDP growth and relatively stable or only low growth in consumption.

Figure 3: EU-25: long-term development of GDP, energy demand and energy intensity (baseline), 2000=100



Source: European Commission Green Paper (2005), *Doing More with Less – Green Paper on Energy Efficiency*

UK's position in a global landscape – consumer products

1.6 A comparison of UK/EU products standards with the rest of the world shows that the UK/EU leads worldwide in terms of its energy performance standards for washing machines and dishwashers. The UK has minimum energy performance standards and best practice guidance in place for heating demand reduction (U values and air leakage standards) but is not the world leader. It has patchy coverage in terms of minimum standards for a range of other white goods and heating products and limited or no coverage in consumer electronics, domestic lighting, cooking and ICT. The UK/EU has few energy performance standards for motors, drives and commercial lighting and no leadership position in these categories. No UK/EU minimum standards exist for commercial air conditioning and commercial lighting. The UK/EU has very few endorsement standards and little best practice coverage except in the case of domestic boilers, gas water heaters, domestic heating demand reduction and ICT. However, where UK/EU standards are in place, over 40% of the standards lead worldwide.

THE DOMESTIC CONTEXT – UK CARBON EMISSIONS

1.7 Whilst the UK has made good progress on reducing greenhouse gas emissions overall and is well on course for meeting the Kyoto Protocol target (a 12.5% reduction in greenhouse gas emissions below base year levels by 2008-12), a significant effort will be needed to meet the domestic 2010 goal of a 20% reduction in carbon dioxide below 1990 levels.

1.8 Revised emission projections suggest that the UK will have reduced carbon dioxide emissions to around 10% below 1990 levels by 2010. These projections are currently being revised in the context of the review of the Climate Change Programme.

Table 1: Carbon dioxide emissions by end user, 1990-2010

End user sector	Million Tonnes Carbon (MtC)		
	1990	**2005**	**2010**
Business (including industrial processes and waste)	68.4	58.4	57.3
Transport	40.2	43.9	44.7
Households	45.2	41.2	39.0
Public	8.7	6.0	5.9
Other sources	2.3	0.5	0.6
Total	**161.3**	**147.6**	**145.2**

2 HOUSEHOLD SECTOR

2.1 Households are responsible for carbon emissions of just over 40MtC per annum, around 30% of the UK total. This is dominated by space and water heating (around 75%) with lights and appliances responsible for the remaining 25%.

2.2 The report published by the Energy Saving Trust (EST) suggests that there is scope to deliver around 9MtC of cost-effective savings by 2020, with most of this (7.5MtC) coming from measures tackling space and water heating, and 1.5MtC from appliances. The review identified two distinct types of decisions impacting on energy efficiency investment (ie additional to the low or no cost behavioural measures such as turning lights off, turning down thermostats, etc): those concerning one-off measures solely driven by energy saving, such a retrofit insulation or heating controls, and the purchase or replacement of fittings or appliances, such as boilers or appliances, where the decision to purchase is not itself driven by energy saving, but there is scope to choose a high efficiency option. Potential carbon savings from these two routes appear to be similar, but the levers to influence these two types of decision are very different.

2.3 The Government's Energy Efficiency Action Plan, published in 2004, set out a range of policy initiatives which were projected to deliver carbon savings within the household sector of 4.2MtC by 2010. These polices are being evaluated through the review of the Climate Change Programme.

BUILDINGS

2.4 The current package of measures under the UK Climate Change Programme[1] has succeeded in delivering significant improvements to existing buildings and raising the energy performance of new buildings. The Energy Efficiency Commitment (EEC) has driven the installation of insulation measures, particularly in social housing, as well as promoting high efficiency boilers ahead of their incorporation into the Building Regulations earlier this year. The first three-year phase of EEC was completed in March 2005, and all obligated energy suppliers met their energy saving targets[2]; indeed most went beyond their targets, carrying over significant surplus into the current phase. Despite compliance issues, current Building Regulations are delivering around 95% of the expected carbon savings, and a further tightening of the regulations is expected to deliver further improvements of around 20% when they are published early next year.

2.5 Together the current package of measures provides a good foundation for further increases in energy efficiency, but several **key challenges** must be overcome.

(i) Current programmes, particularly the Energy Efficiency Commitment and the Decent Homes programme, have delivered the majority of their savings from social housing. Going forward, ways need to be found to deliver effectively among owner-occupiers, and also from an even more difficult sector, private landlords. By the end of the decade the installation of cost-effective insulation will become largely exhausted in the social sector. However, there is still a large prize to be gained from promotion of energy efficiency to owner-occupiers and

[1] Key elements include the Energy Efficiency Commitment (EEC), Building Regulations, product standards and labelling, awareness raising and support by the EST.

[2] With the exception of one supplier that went into receivership and did not comply.

private landlords and through the uptake of loft insulation in all sectors of the housing market.

(ii) The current package of measures for the domestic sector is not adequately addressing all the key barriers. In particular, the report published by EST suggests that there is a lack of focus on behaviour and how to incentivise behavioural change. Existing programmes mainly rely on physical measures, but increasingly these need to extend to behavioural measures too, to reduce heating hours, internal temperature, lighting levels and appliance usage.

(iii) There is a need to draw in new physical measures to maintain the rate of energy efficiency improvement as measures currently being installed are likely to reach saturation point early to mid next decade. These new measures include solid wall insulation for existing properties, low carbon technologies and high insulation products in new homes.

OPTIONS FOR NEW OR EXPANDED POLICIES ON BUILDINGS

(i) Energy Efficiency Commitment

2.6 A supplier obligation such as the EEC is an effective route to drive energy efficiency take-up, particularly for housing fabric measures. The analysis undertaken by EEIR consultants Oxera shows that EEC is much more effective than a simple grant scheme or discount on insulation measures. Access to the consumer is a key factor in delivering carbon savings, so an energy supplier-led programme remains key to driving further energy efficiency improvements in the home. A further increase in the EEC target after 2008, to triple the EEC1 level, is feasible (roughly a 50% increase again on the current phase of EEC2), provided that two key barriers are addressed: firstly the cost perception gap, where consumers have poor knowledge of the costs and benefits of measures, and tend to overestimate the costs and installation time while underestimating the savings; and secondly distrust of the supply chain.

2.7 However, individual energy suppliers working alone are poorly placed to deal with these barriers, and Government will need to work with the suppliers and the Energy Saving Trust to ensure that they are overcome. Government will bring together business, academic and other interested stakeholders to discuss whether EEC can play a role in broadening knowledge of energy efficiency measures at an Energy Services seminar on 18 January 2006. The event will provide an opportunity to discuss how EEC and other measures could facilitate an increase in the uptake of energy efficiency measures in the wider context of moving from a market which provides units of energy to one which addresses the heating, lighting and power needs of the consumer. Government will also need to consider widening the base of measures eligible for EEC activity, as well as exploring the possibility of an increased role for trading within the EEC framework.

2.8 Oxera's survey suggested that cost effectiveness is not a key driver for the installation of loft or cavity wall insulation. The potential savings in fuel bills from insulation does not appear to be a significant factor in consumers' decisions, although feedback from energy suppliers has suggested otherwise. Up front costs, the reliability and reputation of the installer, the perceived "hassle factor" and personal recommendation are all more important. Innovative supplier schemes such as Centrica's Council Tax Rebate scheme operating in Braintree can provide a way to overcome the lack of cost saving as an incentive to the installation of measures and to overcome the general mistrust of the supply chain. If these are not enough, the

Government could address these market failures via support programmes. Such programmes can help close the cost perception gap, generate a system of "neighbour recommendation", overcome distrust of the supply chain, and overcome the lack of awareness of accreditation in the insulation sector, which emerged as a very significant factor.

2.9 The review considered the incentivisation of energy efficiency measures to owner-occupiers through one-off reductions to the up-front cost of insulation, either offered annually or at the point of house move. Modelling work based on Oxera's consumer survey indicates that price changes alone will have little impact on uptake for cavity wall insulation and loft insulation. Despite the fact that up-front price is an important issue, it is not a sufficient driver on its own for a subsidy to overcome the barriers of "hassle factor", distrust of the supply chain, lack of awareness of accreditation and the lack of recommendation. If these price reductions were to be delivered via local government, through council tax rebates for example, then the added effect would be to raise levels of awareness and create greater trust than the energy suppliers could achieve on their own. Subsidy offered at the point of house move did not emerge as a strong option, largely because it would take a long time to cover the whole stock of existing homes.

2.10 The household sector report recommends that Defra considers the scope to move EEC towards a supplier cap and trade scheme after 2011. Such a scheme would move the objective away from the installation of physical measures (which do not always correspond well with absolute energy or carbon savings) towards direct delivery of carbon or energy targets. This would support an energy services approach to delivery of carbon and energy savings. And suppliers could choose from a wider range of measures including those which address behavioural change as well as the more traditional technological solutions. But this would represent a significant change from the existing policy framework, and the technical, social and competition issues arising from this proposal will require further study.

2.11 Market misalignment is a key barrier in private rented accommodation, where any cost savings from the installation of energy-efficient heating are difficult to recover in increased rent. The only solutions likely to change landlord decisions are either direct regulation, such as a minimum energy performance rating, or a discount on the installation cost of measures, and this may have to be over 100% of the cost to be effective.

2.12 Energy consumption feedback to consumers has emerged as a potentially very cost-effective measure. Studies conducted in the USA and Europe indicate that the provision of either detailed information in bills or of readily accessible real-time displays within the home can generate 5-10% sustained reductions in energy consumption. Such a system would provide an important means of delivering energy savings under a supplier cap and trade scheme. The provision of smart metering and consumption information are currently under negotiation as part of the Energy End-Use Efficiency And Energy Services Directive. However, there is little available data on the impact of such schemes in the UK, and the review highlights the need for the Government to work with the Regulator and energy suppliers to evaluate further the potential of different forms of enhanced feedback to consumer feedback.

(ii) Building Regulations

2.13 The review of international energy efficiency confirmed building standards as one of the most consistently effective policies. The forthcoming revision of the energy

provisions (Part L) of Building Regulations is now due in 2006, and potential for further cost-effective tightening in 2010 remains. For homes with gas heating, a 25% improvement over the 2006 Regulations is possible based only on improved insulation, but homes heated by gas or electricity would require more expensive technologies such as renewables or heat pumps. But these opportunities will diminish after 2010, based on existing construction methodologies and technologies. Further improvements will require the increasing deployment of low carbon technologies such as solar water heating, small-scale renewables, micro-CHP and heat pumps. To bring the costs of these technologies down in advance will require a significant number of homes to be built to the higher standards. Of the options considered by the review, the most viable appears to be a Builders' Obligation, whereby the volume house-builders would have to meet the standards of the Sustainable Buildings Code for a small fraction of the houses they build each year. This would help drive down costs of new technologies by increasing their market penetration rate. It would require new legislation and agreement on targets, which could be up-rated in line with changes to Building Regulations. Such a scheme would be market-based, giving it flexibility and improved cost-effectiveness and would provide certainty in terms of targets and carbon delivery. The issues of potential extra burden on builders and overlap with EEC would need to be explored as part of further work to assess this proposal.

2.14 Compliance with Building Regulations is also an issue. In a study of 99 new dwellings conducted in 2004, one third failed to achieve the recommended level for air tightness, although the shortfall in overall delivery of carbon savings is less than 5%. At the moment, the impact on average carbon savings is low because the air tightness standard is low and the air tightness in compliant buildings is well above the regulatory requirement, so compensating for the non-compliant shortfall. ODPM have identified the causes of non-compliance as poorly understood regulations and lack of skills within the buildings workforce. These issues are being addressed through the drafting of the 2005 regulations and the introduction of training programmes. Air tightness is expected to become a more critical feature as Building Regulations tighten, potentially increasing the carbon losses from non-compliance. The Government's review of what more can be done to improve the efficiency of existing buildings also presents an important opportunity to re-examine the scope to improve the energy standards of existing housing stock, which will predominate emissions from this sector for many decades.

CONSUMER GOODS

2.15 Although appliances and lighting account for just under 20% of household energy use, longer-term energy and cost savings do not drive consumers' decisions to purchase many electrical goods; price is the key factor, as is personal recommendation. However, where an energy label exists, such as for fridges and freezers, the energy rating of the product is an important factor in influencing consumer choice.

2.16 Market penetration by energy-efficient class A products has increased steadily over the past 5-6 years; however, fewer A+ and A++ products are sold in the UK than the rest of Europe. Cost is probably the main issue preventing further market penetration of these products. Technologically, the existing standards and labels no longer act as a driver to improvement; present technology is capable of meeting the highest standards currently available.

2.17 The infiltration of energy-efficient domestic lighting is also affected by a market misalignment. The financial benefit of low energy lightbulbs is not a significant consideration in purchasing decisions. Poor quality lights and fittings, lack of product

information and mandatory standards together with a lack of compatibility of compact fluorescent lightbulbs with tungsten fittings, light shades, etc, all detract from customer acceptance.

2.18 In addition, the standards and labelling requirements under current EU legislation are open to interpretation by manufacturers. There are no agreed standardised procedures for measuring performance or for monitoring compliance. This means that it is often not possible to compare performance between specific products and that the actual performance of products within a particular rating band has a wide range of variance.

2.19 Product policy built around the use of minimum energy performance standards and labelling provides a cost-effective means of reducing carbon.

ABATEMENT OPPORTUNITIES ON CONSUMER GOODS

2.20 The success of current minimum energy performance standards and energy labelling schemes indicates that there is scope to introduce standards and labels to a wider range of products and to uplift existing standards at the EU level.

2.21 Within the UK, there is scope to promote the sale of energy-efficient consumer goods through use of price incentives, government endorsement standards (procurement standards) and through a retailer obligation scheme.

2.22 The fast-paced nature of the electronics industry, and strong competition within the electrical goods market based on price, means that the present schemes are too limited in scope and are in danger of running out of headroom. These issues can be addressed by influencing action at EU level to up-rate labelling and standards for white goods and to introduce new product standards and labelling information for consumer electronics and lighting. If implemented immediately these could save a total of over 1MtC by 2010, with around one third coming from white goods and domestic air conditioners, and the remainder from the introduction of a new label for digital receivers and powers supplies.

2.23 However, for some rapidly growing consumer electronics products, EU progress may be too slow. The report published by EST suggests a number of actions that could be taken at UK level to encourage sales of more energy-efficient goods:

- A retailer obligation which would require retailers to sell a proportion of identified goods which meet minimum energy standard (i.e. a retailer version of the Japanese “Top Runner” approach, which applies to manufacturers). This was considered by not favoured. However, there is scope to agree voluntary labelling schemes for key products, such as white goods, under EST’s “Energy Saving Recommended” scheme, and then to supplement this by a voluntary agreement with retailers to raise the energy performance of the products they sell.

- Establish government procurement standards for a wider range of goods and uplift present standards. By extending the existing Energy Efficiency Recommended scheme, Government can influence the minimum energy rating of a range of products that are available for both commercial and domestic use. Further work is under way to model the strength of such a signal in business-to-business procurement routes and to determine the size of the carbon saving if minimum standards were adopted across the civil service. In the short term such standards could be introduced by the

Government's "quick wins" scheme, prior to the introduction of its wider sustainable procurement standards currently being developed by the Sustainable Procurement Task Force.

- Use product price changes to promote the sale of the most energy-efficient products. EEC has helped to drive sales of more energy-efficient fridges and washing machines. However, UK sales of the most energy-efficient appliances (A+ and A++) are below that of western European countries. Additionally, new, more energy-efficient technologies are available but are unable to compete on price. A product price change, either a subsidy on the best performing appliances or a charge on the worst performing, could provide an additional driver to increase market penetration of more energy-efficient products.

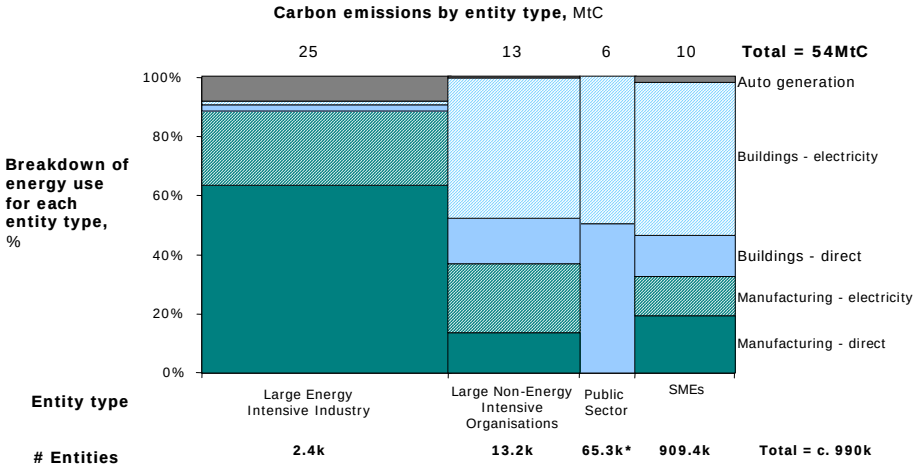
Summary of key conclusions and suggested actions proposed by the report on the household sector published by EST

Conclusion	Suggested further action / next steps
There is a strong case for increasing the EEC target by a further 50% from 2008, and for considering the case for moving to a supplier energy or carbon cap from 2011.	Support measures to underpin increased supplier obligations, further work to examine the potential for trading within the existing framework, and signal possible supplier cap and trade scheme.
Improved consumer feedback appears to be a very cost-effective way to tackle energy demand, but better data on UK applicability required.	Additional work to confirm potential of energy consumption feedback to consumers, then implement most cost-effective solution.
There is scope to cost-effectively tighten Building Regulations further in 2010. Additional incentives are needed to encourage private housebuilders to build homes to standards above Building Regulations – to the Sustainable Buildings Code (SBC), for example.	Tighten Building Regulations in 2010. Evaluate options for introduction of a builder's obligation or other incentives for private sector adoption of SBC.
Action needs to be established under the Eco-design of Energy Using Products Framework Directive to introduce new or improved product standards and labelling.	Work with Commission and other EU MS to accelerate up-rating of product policy. Standby consumption should be a priority.
National action is justified for fast-moving product types where EU programmes may be too slow.	Implement endorsement standard/labelling for key consumer electronics and initiate retailer code of practice discussions.
Existing policy options are unlikely to drive improvements to existing properties for private landlords.	Examine options for regulation of private landlords.
Effective enforcement of standards – for buildings and products – is essential.	Ensure appropriate action is taken on enforcement of Building Regulations and product standards / labelling.

3 BUSINESS AND PUBLIC SECTOR

3.1 The Carbon Trust has fed an independent study on the potential evolution of the Climate Change Programme for business and public sector into the Energy Efficiency Innovation Review. The following is a summary of the analysis undertaken and findings (the Carbon Trust are publishing the full study). This work focuses on how policy can reduce the demand for end-use energy in the business and public sector (but not the reduction of the carbon intensity of energy supply, e.g. electricity generation, CHP and renewables). The aim of the Carbon Trust's work is to understand how policy measures might evolve to deliver significant carbon savings while at the same time maintaining or enhancing the competitiveness of UK companies.

Segmentation of UK business and public sector carbon emissions, 2002



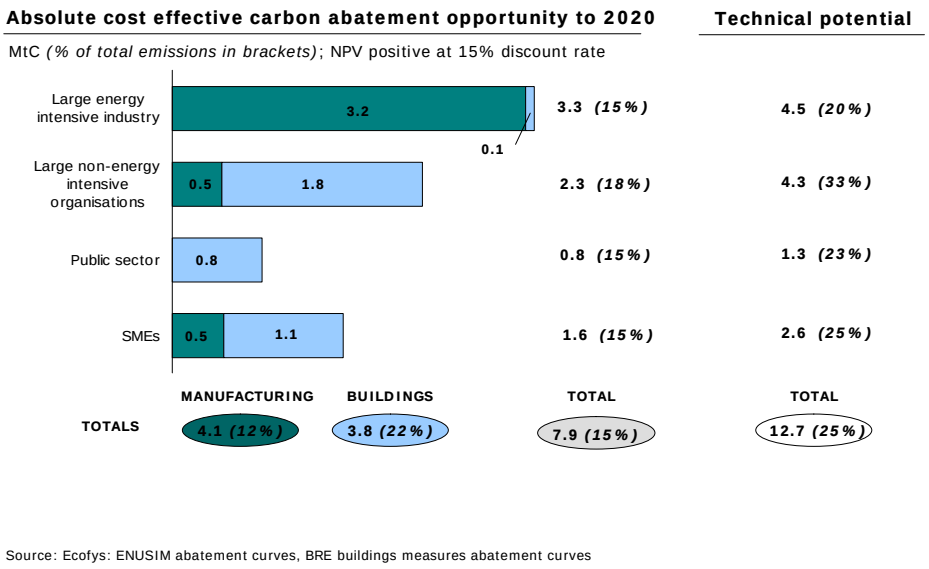
Source: Ecofys

3.2 In 2002, the business and public sectors within the UK generated 54MtC. 46% of these emissions arise from large energy-intensive companies in sectors largely covered by the EU ETS or CCA schemes. Small and Medium sized Enterprises (SMEs), including both service and industry sectors, make up about 20%, large non energy-intensive private sector organisations and the public sector make up the remaining 34%. Large companies as a whole constitute about two thirds of the sector emissions. In terms of energy uses, energy in manufacturing processes, primarily by the large energy-intensive industries, accounts for 56% of all carbon dioxide emissions; the use of energy for heating, lighting and power for IT, etc within buildings, primarily in the non energy-intensive industries, the public sector and SMEs, accounts for 40%, but is growing more rapidly.

ABATEMENT OPPORTUNITIES

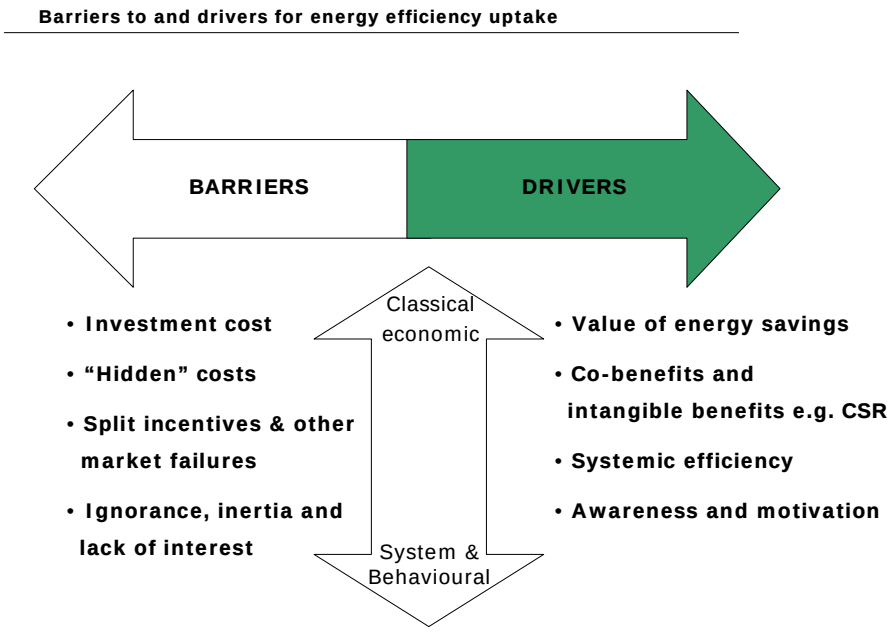
3.3 As part of the EEIR, consultants Ecofys and Enviros have examined the opportunity for the business and public sectors to make further carbon savings. They have concluded that significant cost-effective abatement opportunities exist both in the

large energy-intensive market segment, and importantly also across the other three segments (around 60% of the total), particularly within buildings, based solely on use of existing commercially available technologies.



Source: Ecofys: ENUSIM abatement curves, BRE buildings measures abatement curves

3.4 Analysis by the Carbon Trust indicates that there are many barriers to the uptake of greater energy efficiencies by the business and public sectors, and that from a policy perspective these fall into four main groups which need to be set alongside the drivers of company decision-making:



- Investment cost, set against the value of energy savings, where the major policy levers concern straightforward economic instruments;
- "Hidden" costs associated with adopting more efficient equipment, e.g. concerning the perceived risks of poor performance, transitional problems, and the transaction costs of acquiring information and making sound, informed judgements on the value of available opportunities. Equipment standards may be particularly effective ways around this barrier, and policies can also tap into "hidden" benefits such as corporate social responsibility (CSR) drivers;
- Market failures that result in split incentives, e.g. the "tenant-landlord" split where tenants pay the energy bills but landlords control the properties. Metering can also be a victim of split incentives, where utilities do not have any incentive to help their customers monitor energy use effectively;
- Organisational inconsistencies, that result in misalignment of return on investment within an organisation such that differing values are placed on the rates of return on investment by different parts of the organisation, or stemming from ignorance and inertia on the part of decisions-makers. Addressing this often requires senior-level commitment in the company.

3.5 In the case of the large energy-intensive companies, technical cost benefit is a major influence on uptake of further cost-effective energy-efficient measures, but other drivers/barriers dominate in the other market segments, creating a substantial potential for cost-effective gains if policies can tap the opportunities.

THE CURRENT SITUATION

3.6 The present package of measures in place to reduce carbon emissions from the business and public sectors has a number of powerful building blocks in place, notably the EU Emissions Trading Scheme (EU-ETS), Climate Change Agreements (CCAs), Building Regulations and Energy Performance of Buildings Directive (EPBD). However, across all of these instruments implementation issues could limit their ultimate carbon delivery. Moreover, Carbon Trust's analysis suggests that the current package needs to provide a greater incentive for change across the less energy-intensive segments, where energy costs and the Climate Change Levy (CCL) paid are less material and structural failures persist.

3.7 The EU-ETS and CCAs (backed by the CCL) are the key regulatory instruments in the large energy-intensive industries while the CCL is the main economic instrument covering large non energy-intensive organisations, the public sector and SMEs.

3.8 The EU ETS provides a structure for incentivising change in its core industry sectors whilst minimising competitiveness impacts. The CCAs provide an incentive and awareness raising effect for securing low-cost gains in the rest of energy-intensive industry. The CCAs overlap with EU ETS for many heavy industry sectors, creating an additional regulatory burden. In the short-term (until end of phase 2 of the EU ETS) this overlap does however help to ensure domestic abatement even if EU ETS generates a weak price for carbon. The Government has announced that sectors with CCAs that choose to opt into the EU ETS instead will be allowed to retain the 80% relief from CCL, without having to retain their current CCAs for their direct emissions, but will still need to meet CCA targets for their electricity related emissions. In practice no sectors have taken up this option, maintaining their current overall CCA emissions reductions

targets, as it would be too complex to change their existing targets by splitting out the electricity component.

3.9 The strength of enforcement and compliance of Building Regulations is also a concern and the definition of the Energy Performance of Buildings Directive (EPBD), which is soon to be introduced, may be restrictive (e.g. of public buildings). Building Regulations and EPBD offer the levers to drive significant change in building stock assets. Building Regulations also help to drive change through new builds and refurbishments. However, as annual new build and refurbishment rates represent around 1-2% and 2-3% of the existing building stock respectively, Building regulations will only deliver significant impact in the long term. The Energy Performance of Buildings Directive on the other hand acts on the existing stock and has the potential to help overcome the landlord-tenant divide through its separate asset and operational ratings. The ratings will increase the transparency of the performance of buildings and will list improvement opportunities.

3.10 Other studies have suggested that the original announcement of the CCL generated an initial impact through an "announcement effect" in the public and commercial sectors, and that the CCL has been very effective in combination with the CCA in energy-intensive sectors. However, across the less energy-intensive sectors, energy costs and CCL paid are less material. Market misalignments (e.g. tenant-landlord split) persist and other drivers (e.g. investor, customer or employee pressure) that could overcome organisational and behavioural barriers in large organisations are not being fully leveraged by the current Climate Change Programme. Other instruments will also be required to overcome specific barriers in the public sector and for small and medium sized organisations. Furthermore energy information via adequate metering systems is poor and hence a primary obstacle to delivering any strengthened CCP outcomes.

OPTIONS FOR NEW OR EXPANDED POLICIES

3.11 The Carbon Trust report concludes, therefore, that there is scope to strengthen the existing business and public sector package to substantially increase carbon delivery from these sectors. Delivery from energy-intensive sectors will depend on the allocation of permits from phase II of the EU ETS. If a strong and stable ETS is secured, the Carbon Trust suggest that there could be scope to remove the overlap between the EU ETS and the CCAs. However, none of these would address the main barriers in the rapidly growing less-energy-intensive sectors. The Carbon Trust have therefore suggested that a new instrument is required.

3.12 Having investigated various routes to incentivise change in less energy-intensive organisations, the Carbon Trust study concluded that one option worth exploring in further detail is a new simple mandatory UK consumption-based Emissions Trading Scheme covering both direct and indirect emissions (fossil fuel and electricity usage respectively). This scheme would apply to companies and public sector organisations, rather than be site-based (EU ETS) or sector-based (CCA). The proposed scheme would exploit the capacity of large firms and organisations to manage their energy and company commitments, increase the transparency of energy use and leverage corporate social responsibility drivers, by making their progress to date and carbon management strategy clear to investors, customers and employees alike. However, the Carbon Trust stress the need for any such scheme to be simple and to avoid additional financial burdens for firms and suggest it would have the following defining features:

- A company/organisation level trading scheme, in which companies must acquire allowances to cover their total emissions from sites across the country and may freely trade them between all other companies in the scheme.
- Both direct and electricity-related direct emissions could be included (electricity could be accounted at grid average carbon intensity, or supplier-specific intensities).
- Transaction costs could be minimised by:
    - Focusing the scheme on large companies (e.g. based on either energy consumption, turnover or employment threshold);
    - Basing the emissions on good metered energy bill data using existing gas and electricity meters (possible selection criteria could include whether sites have 1/2hr electricity metering, only generally provided to sites with energy consumption above a specific threshold).
- Trading results could be published in annual reports in consistent fashion: year on year total emissions, sales and purchases.
- Full auctioning of allowances could avoid gaming and transaction costs associated with allocation and negotiations, and accompanying CCL rebates could prevent an additional financial burden for business.

3.13 The simplest implementation would auction all the allowances to avoid the complexities and administrative costs of company-specific negotiation. Potentially the scheme could also be linked to allow purchase from EU ETS sectors, which could ensure price parity and stability with the EU ETS. Regardless of how it was designed, the Carbon Trust highlight the need for further work to ensure the design of any such scheme did not create an administrative or financial burden for firms and government, or other adverse competitiveness effects.

3.14 Although the trading scheme as described focuses on direct and electricity-related emissions, other sources could potentially be included to provide a more holistic, joined-up incentive for companies to manage their overall carbon emissions.

3.15 The core rationale for this scheme is that the need to acquire, at company level, allowances and to verify this against corporate energy use would address several barriers far more effectively and efficiently than having numerous sites around the country just paying their energy bills. It would achieve this by getting the issue of carbon management into the managerial structures of large, efficient companies with numerous small sites, thus leading them to concentrate expertise, compare the performance of different sites, and minimise site-level transaction costs, whilst leveraging also the non-economic drivers associated with transparency of company carbon emissions.

3.16 The Carbon Trust report argues that additional measures would still be required to address particularly the many barriers associated with building structures. As described, Building Regulations and the Energy Performance in Buildings Directive (EPBD) can drive change in building stock, but enforcement and compliance of Building Regulations are patchy and definitions (e.g. of public building in EPBD) may be restrictive. “Part L inspectors” focussed on large buildings (>1000m2) with ability to

oblige changes may greatly increase the implementation of Building Regulations. Extending the definition of "public building" for EPBD – perhaps requiring all large public access buildings (e.g. >1000m2) to obtain and display a certificate stating the in-use performance of the building - together with an obligation to implement "easy" measures in asset rating certificates - could greatly increase its impact.

3.17 Small and Medium sized Enterprises (SMEs) are particularly difficult to target cost effectively, both because of their diversity and the owing to the lack of time, resource and expertise they have to apply to these non-core issues. The Carbon Trust report argues that product standards and labelling could be used with great effect across the business and public sector as a means to remove the least efficient products from the market place, and are a particularly effective way of driving change in the SME market. The Government's Enhanced Capital Allowance Scheme, and associated Energy Technology List, helps to inform buying decisions and influences the products manufacturers bring to market – the criteria for qualifying technologies should be regularly tightened. Interest free loans for SMEs will also help to overcome the barrier that many small firms have of inadequate access to capital.

3.18 Finally, the Carbon Trust report argues that far stronger public sector leadership can both set a behavioural and strategic example to the private sector, and leverage its large purchasing power (responsible for one third of non-domestic new build and refurbishment in 2004). This could include top quartile energy performance procurement and rental. Meeting the established target to reduce public sector carbon by 12.5% by 2010 will require greatly improved governance (which is currently lacking), tighter procurement guidelines, extension of ring-fenced interest free loans, and extension of other support mechanisms.

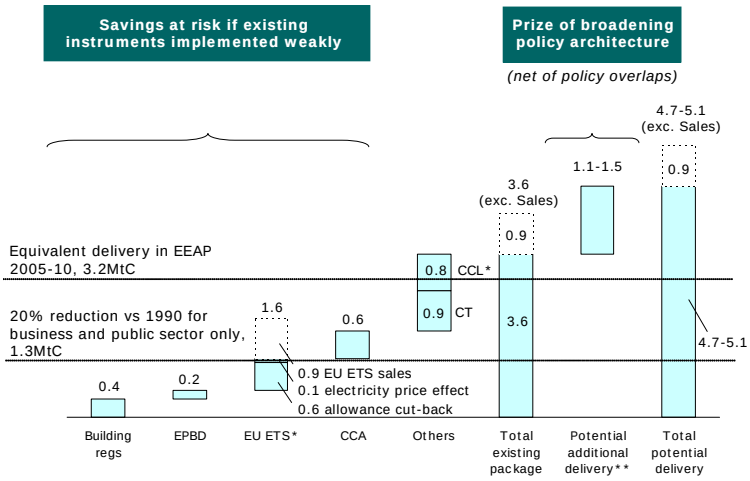
IMPLICATIONS OF KEY POLICIES

3.19 The Carbon Trust conducted analysis of the carbon delivery of the policy packages they suggest. A range of high and low price scenarios were analysed and it was found that a strengthened package could deliver up to 4.7-5.1MtC/yr by 2010 and around 11.2-12.6MtC/yr by 2020 – about 10% and 20% respectively of projected emissions from these sectors (see figures) – and therefore turn slow projected growth in emissions into absolute decline averaging about 1%/yr. In 2020, around 9MtC/yr of this delivery comes from the existing policy package at its current strength (assuming existing instruments are implemented to maximise carbon savings) whilst the net prize of broadening the package of measures is an additional saving of 2.2-3.6MtC/yr. Over 90% of these savings can be delivered by technologies that are profitable at 15% cost of capital and the energy prices projected before recent price rises: efficient implementation thus offers the technical potential for net benefit to UK firms. The 2020 delivery does not take account of innovation in end-use technologies that would be expected to arise from the stronger implementation policies.

3.20 The Carbon Trust analysis shows that power sector fuel-switching arising from the EU ETS could increase the short-run carbon value of end-use efficiency by up to 40%. This would add greatly to national carbon savings, which by 2010 could exceed 10MtC/yr just from the EU ETS and from strengthening existing CCP instruments (compared to pre-ETS CCP conditions), according to analysis by Cambridge Econometrics.

2005-2010 Carbon delivery

2010 MtC pa saving vs projected emissions (60MtC)***

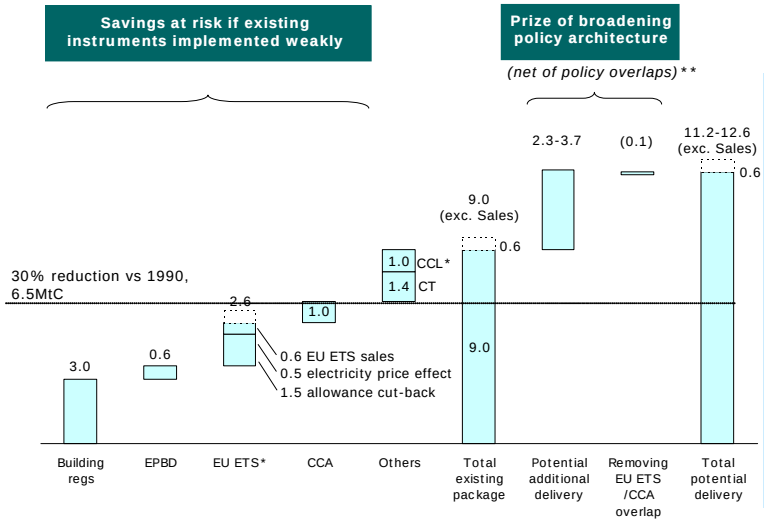


- Base case delivery of existing package close to Energy Efficiency Action Plan estimate (~3MtC), however mix of instruments is different
- Building regs and EPBD delivery still low as insufficient churn of stock
- Broadened package, including UK consumption-based emissions trading scheme, capable of delivering additional 1.1-1.5 MtC

Note: *EU ETS based on market price of €15/tCO2 and 1%pa cut back, CCL at current strength; **Additional delivery of focus package including UK consumption-based emissions trading scheme (CETS), strengthened product standards and EPBD, net of policy overlaps (including overlaps with CCL and CT); ***Allowing for CCP delivery 2000-2005 (3MtC)
Source: Ecofys

2005-2020 Carbon delivery

2020 MtC pa saving vs projected emissions (58MtC)***



- Building regs and EPBD key route to deliver change in buildings
- EU ETS and CCA effective for energy intensive sectors, with little loss on removing overlap in regulation post 2010
- Broadened package, including UK consumption-based emissions trading scheme, has potential to deliver additional 2.2-3.6 MtC

Note: *EU ETS based on market price of €30/tCO2 in 2020 and 1%pa cut back, CCL at current strength; **Additional delivery of focus package including UK consumption-based emissions trading scheme (CETS), net of overlap with CCL and CT (includes 0.5MtC from strengthened EPBD and 0.7MtC product standards – only additional to UK CETS in SMEs); ***Allowing for CCP delivery 2000-2005 (3MtC)
Source: Ecofys

4 NEW DEMAND-SIDE ENERGY-EFFICIENT TECHNOLOGY

4.1 Because there is still a huge potential for energy efficiency improvements through the faster take up of existing energy efficiency technologies and services, the bulk of this review has focused on this aspect. However, looking forward beyond 2010, there will be an increasing need to bring forward and deploy new and emerging energy efficiency technologies, products and services. The Energy Efficiency Innovation Review has therefore analysed the current level and type of support for energy efficiency innovation and considered the opportunities and benefits to be gained from raising the level of Government funding for research, applied research, development and demonstration (RD&D) across a range of potentially high-impact energy efficiency technologies.

STRATEGIC CONSIDERATIONS

4.2 Government intervention is an option for consideration when the market is not delivering public policy goals as fast or as effectively as is needed. The rate of improvement of energy efficiency is one such case. RD&D is part of the process of technology innovation and commercialisation. However, it is not the whole story. In addition, steps which are as important but less well appreciated include: the development of codes, standards and test procedures; product (or building) labelling in order to differentiate new product performance from old - and thereby begin the process of market transformation; minimum standards for products; and the development of higher quality standards for the product supply chain, including training for installers and specifiers. These steps need to be considered in a holistic way, otherwise policy goals will not be achieved. Therefore, support for RD&D needs to be considered in the context of: accelerating the natural process of market transformation; addressing gaps in the process (such as the current inadequate attention being paid to demonstrations, monitored trials and "learning by doing" projects); and building confidence in the minds of product manufacturers and suppliers that a faster pace of technology innovation will bring them commercial returns at acceptable risk. The aim should be to stimulate the transfer of investment from existing technologies and products to the innovation and commercialisation of new and emerging technologies and products.

4.3 Support for RD&D alone will therefore not deliver an increase in the rate of energy efficiency technology innovation and commercialisation. To make a material difference, the policy support framework needs to be holistic, systems based and coordinated. Government intervention is likely to be needed to increase the rate of energy efficiency improvement – by creating more buoyant markets for energy-efficient products generally and through technology innovation specifically. Creating a pipeline of energy efficiency technology RD&D opportunities requires the right platform of policies and measures to:

(i) increase the rate of deployment of existing technologies and measures by providing a long term, stable signal to the market – thereby not only achieving energy and carbon savings but also providing returns to the technology supply chain and confidence that it is worth making private sector investments in RD&D and applied research leading to new product development. (Measures could include emissions trading, Building Regulations, enhanced capital

allowances, product standards, public procurement, the EU Energy Performance of Buildings Directive, etc.);

(ii) incentivise product improvement and applied, commercially-driven research with significant private investment. (Measures could include blue skies research grants, R&D grants, wider use of tax credits to stimulate incremental and step change R&D, incubator support, venture capital investment, sector technical and infrastructure support, demonstration projects, minimum standards, etc.);

(iii) develop the necessary skills at all levels to ensure the steps from design through installation to operation are not compromised;

(iv) encourage higher supply chain quality standards to improve consumer/customer confidence;

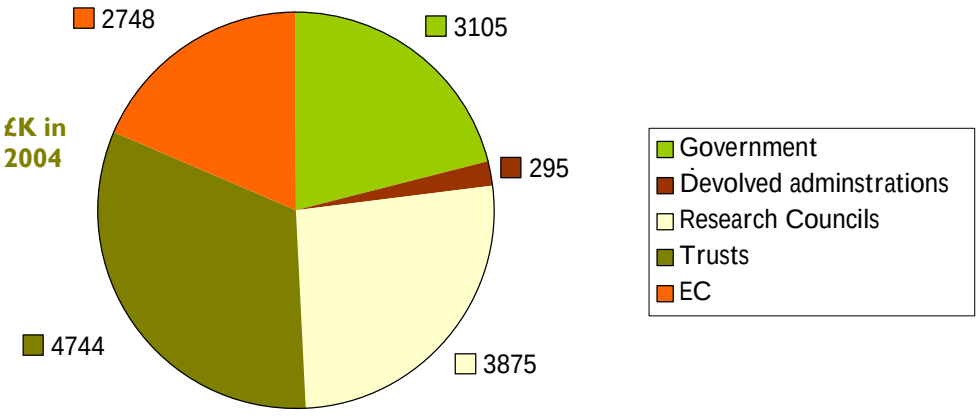
(v) raise awareness, overcome myths and misunderstandings about the cost-effectiveness of energy efficiency technology;

(vi) provide support for training schemes for installers, specifiers, etc.

CURRENT RESEARCH DEVELOPMENT & DEMONSTRATION ACTIVITY

4.4 Over the period 2002-2005, the UK spent approximately £15m per year on RD&D into demand-side energy-efficient technology: about £12m from UK public bodies and £2.8m from the European Commission Framework Programmes. In comparison, over a similar period, £150m per year was spent on renewables research. Industry contribution to energy efficiency research is at least £7m per year although this is probably an underestimate, as it is based on incomplete information. The Engineering and Physical Sciences Research Council (EPSRC), the Carbon Trust and the EC are the three largest individual funders of research within the UK.

Figure 4: UK RD&D expenditure on innovation in energy efficient technologies, 2004: expenditure by public bodies



4.5 Just over half of the expenditure is focussed at the research stage with no expenditure on pre-commercial RD&D within the UK. About £2.4m is spent on bench scale and pilot scale studies and approximately £3m on demonstrators (not including demonstration of renewables technology within buildings).

4.6 The focus of RD&D effort is on buildings research, commanding just over half of all expenditure. Of this, over half (52%) was spent in 2004 on building fabric and construction; a third (£4.8m) was spent on RD&D into industrial processes, the majority being on engineering projects, and just over £2m (15%) was spent on RD&D into appliances, with the focus on electronics research.

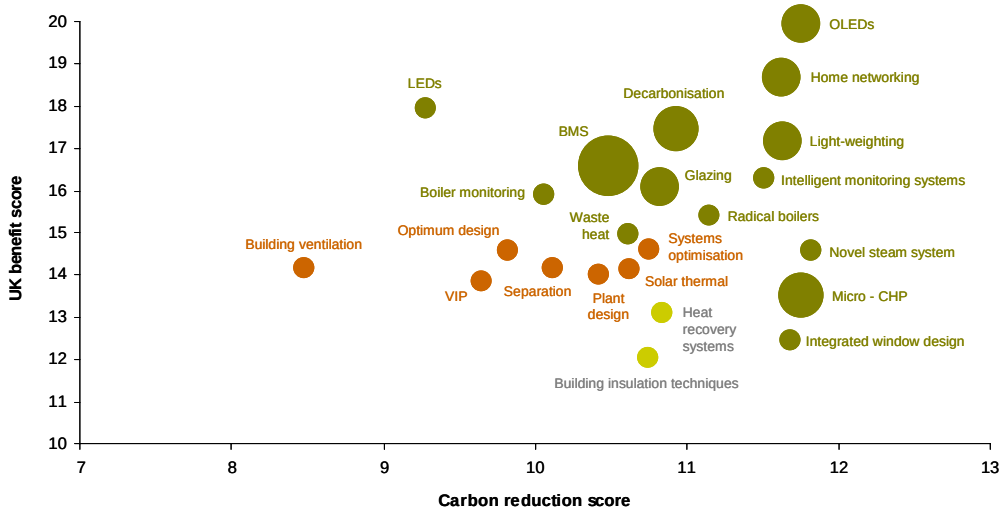
4.7 152 projects were live in 2004, covering 74 different subject areas. RD&D into demand-side energy efficiency is therefore highly fragmented.

4.8 The evidence gathered in the review suggests there is potential for energy efficiency improvements through the development and faster take-up of new and emerging demand-side energy efficiency technologies. For many of these technologies, market pull is weak. Part of the EEIR remit was therefore to look at the potential of new and emerging technologies and services to deliver substantial carbon savings beyond 2010 and the role that Government could play in facilitating that delivery.

4.9 In order to inform Government as to the potential for new technologies to help deliver significant carbon savings in the future, Future Energy Solutions (FES) were commissioned to carry out an assessment of potential new demand-side technologies. They examined the carbon benefit and potential economic benefit to the UK; the barriers that exist to development and deployment of those technologies; and they proposed ways that those barriers could be overcome. Economic benefit for the purposes of this study was defined as where RD&D could return a commercial value to the UK. It included an assessment of UK capability to develop and market the technology.

4.10 FES identified a number of technologies with the potential for both worthwhile carbon savings and UK economic benefit.

Figure 5: Rating of non-commercial technologies by potential for carbon reduction and UK economic benefit*



* The scores for each axis are the sum of the rankings (from 1-5) awarded to the assessment criteria used by FES. The size of the co-ordinate indicates the calculated potential carbon reduction associated with each technology.

4.11 These they grouped into four categories:

- Boilers and steam systems – requiring technology push through applied R&D on boiler and burner design combined with technology pull in the form of regulation and development support;
- Advanced controls for buildings management systems including home networking systems – requiring technology push through demonstration schemes and technology pull through regulation;
- Advanced application of light emitting diodes (LEDs) – requiring fundamental R&D followed later by regulation and government procurement policies; and
- Dematerialisation/lightweighting and decarbonisation of products – requiring fundamental R&D as technology push followed by network support and information exchange.

Table 2: Estimated Carbon saving on introduction of key technologies

Technology	Estimated Carbon Saving by 2020 (MtC)	Estimated Carbon Saving by 2050 (MtC)
Buildings management systems and intelligent appliance control	>1	>8
Insulation of walls and windows – Novel window design	1	>5
Lighting and displays (LED and OLED)	>1	>4.5
Micro-CHP	0.5	3
Light-weighting and decarbonisation	0.3	2
Advanced boiler designs for steam generation and heat recovery	0.08	0.8
Total Estimated Carbon Saving	**>4**	**>24**

4.12 FES estimate that by 2020 the introduction of these technologies could potentially save 4MtC in buildings, industrial processes and appliances.

4.13 Economic benefit would derive from intellectual property rights for buildings management systems, intelligent appliance control and innovative glazing systems, manufacturing of micro-CHP, lighting and display technologies (TV and computer screens), and energy savings from application of advanced boiler designs and heat recovery systems.

4.14 FES's analysis indicated that the UK possesses strengths in its science and industry base for work on LEDs and organic LEDs (for lighting and computer displays), neural networks and fuzzy logic (both buildings management systems and home

networking), sustainable design and materials (lightweighting and decarbonisation), innovative glazing and advanced boiler designs and heat recovery.

4.15 In 2003, the Carbon Trust carried out a Low Carbon Assessment study which included demand side technologies. They considered those low carbon technologies where Carbon Trust intervention would have greatest material impact and where there was significant potential for carbon savings[3]. Of those considered to have high technology impact, the following demand-side technologies were identified: building controls; building fabric, heating, ventilation, cooling and integrated design; CHP (domestic micro-CHP and advanced macro-CHP); and industry (combustion technologies, materials, process control, process intensification and separation technologies). Building lighting and industrial waste heat recovery were considered to offer lower technological impact but had the potential to be high impact through "step change" research.

4.16 In assessments of this kind there will always be differing views about which energy efficiency technologies have the potential to make a big impact but, though no analysis will ever by definitive, there is a degree of overlap between the Carbon Trust's analysis and that by FES. There would therefore appear to be a case for considering a number of energy efficiency technology areas for support. Government can play an important role in supporting innovation and technological development where the market is failing to deliver at scale and on timescales consistent with policy goals. Government will consider the case for further support for RD&D in energy efficiency and the most effective way of delivering it as part of the Comprehensive Spending Review 2007. The UK Energy Research Partnership, bringing together Government, industry, and the research community, will also provide advice on the UK's long-term energy RD&D strategy.

[3] http://www.thecarbontrust.co.uk/carbontrust/about/publications/Low_Carbon_Technology_Assessment.pdf

A KEY INPUTS TO THE EEIR

Key inputs to the EEIR

Title	Subject	Author
Review and development of **carbon dioxide abatement curves** for available technologies as part of the EEIR	An in-depth reappraisal of carbon abatement curves and the carbon abatement potential of non-transport sectors.	Enviros Consulting Ltd
Assessment of emerging **innovative energy efficiency technologies** as part of the EEIR	An evaluation of emerging low carbon technologies and the scope to stimulate these via additional UK RD&D.	Future Energy Solutions
Policies for **energy efficiency policies in the UK household sector**	Review of existing policies and literature on barriers to energy efficiency. Development of a new consumer response model and appraisal of options for new energy efficiency policies.	Oxera Consulting Ltd
International review	A comparison of UK energy efficiency performance and policies with selected countries.	Internal
Comparison of **UK and best international energy standards** as at February 2005	A comparison of UK energy standards with best practice internationally.	Defra's Market Transformation Programme