CARBON TRUST
Making business sense of climate change

The UK Climate Change Programme:

Potential evolution for business and the public sector

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Preface

This report looks at how policy instruments acting on business and the public sector can be optimised to deliver significant carbon savings whilst maintaining/enhancing the competitiveness of UK companies. It explains why energy efficiency must play a central role in the national energy and climate change strategy, where the main potentials lie for energy efficiency improvement, and what are the main barriers and drivers to the take-up of current and upcoming energy efficiency/low carbon technologies in business and the public sector. It then examines in more detail the policy instruments and potential policy packages that could deliver a step change in energy efficiency while maintaining or improving UK competitiveness.

The Carbon Trust, which led the analysis presented here, was established to encourage and promote the development and deployment of low carbon technologies to support the transition to a low carbon economy in the UK. To help achieve these goals in the industrial, commercial and public sectors, the Carbon Trust also seeks to inform policy makers based on real world experience of low carbon technology development and deployment.

The report represents the high-level summary of detailed studies on the options for developing UK policy in the business and public sectors which were carried out by the Carbon Trust as input to the UK Climate Change Programme Review and the Energy Efficiency Innovation Review (EEIR). A balanced national strategy must also address on equal terms the growth of emissions from transport and the domestic sector, which fall outside the remit of the study.

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Executive summary

The 2003 Energy White Paper committed the UK to reducing carbon emissions by 60% by 2050 and to making significant progress towards that goal by 2020. The main aim of this work was to understand how policy measures impacting the business and public sectors might evolve to deliver significant carbon savings while at the same time maintaining or enhancing the competitiveness of UK companies.

This summary provides an overview of our findings in five key areas:

- i **Context**
- ii **Strengths and weaknesses of current Climate Change Programme**
- iii **Addressing gaps in the Climate Change Programme**
- iv **Quantified conclusions on cost and delivery**
- v **Innovation and interactions**

i Context

The business and public sectors generate over one third of UK CO_2 emissions. Significant carbon abatement could be achieved in these sectors while at the same time delivering bottom line financial benefits using existing energy efficiency technology. However, existing policies do not sufficiently target the diverse barriers that inhibit uptake or utilise the corresponding drivers that could most cost-effectively deliver change.

Emissions mapping. Manufacturing processes and commercial and public sector buildings (i.e. excluding all transport and domestic related activity) produce ~54Mt of carbon emissions (based on 2002 data). Within these there are four main classes of users: energy intensive industries (c.45% of business and public sector emissions as defined in this study), large non-energy-intensive companies (c.25%), SMEs (c.20%) and the public sector (c.10%). Energy for manufacturing processes (of which two thirds is direct fuel combustion) dominates the first of these; electricity and other buildings-related emissions dominate emissions from the other sectors.

Carbon abatement opportunity. Significant carbon abatement could be achieved using available technological and behavioural energy efficiency measures that are cost effective, generating a rate of return above 15%. This 'cost effective' potential could reduce emissions by 2020 by at least 12% across manufacturing processes and 20% in non domestic buildings using existing carbon abatement technology. In addition, innovation over this time-frame would be expected to significantly increase the longer term potential.

Barriers and drivers. Policy can deliver this potential only to the extent that it helps to overcome barriers or harness the drivers of business decision-making. Financial cost/benefit considerations that define overall rates of return on a carbon abatement investment are the first overall type of barrier/driver and it can be primarily addressed from a policy perspective through economic instruments such as the EU Emissions Trading Scheme. Three other categories of barrier/driver account for the gap between the cost-effective potential and current implementation:

- 'Hidden' costs associated with adopting more efficient equipment e.g. perceived risks of poor performance, implementation issues, and the transaction costs of getting information and making sound, informed judgements on the value of available opportunities. Equipment standards, or technology labelling and listing schemes, can help address this barrier. Policies can also tap into 'hidden' benefits such as customer, investor, or employee preferences for companies that are minimising their impact on the environment and managing carbon risks (e.g. 'Corporate Social Responsibility' drivers)
- Market failures that result in split incentives, e.g. the 'tenant-landlord' split where business tenants pay the energy bills but landlords control the properties and associated energy services. Primary metering is another example of split incentives, where utilities do not have a strong incentive to help their customers monitor energy use effectively. Potential solutions include contractual and market standards solutions
- Organisational factors stemming from ignorance and inertia, or from internal structures that prevent the relevant persons from realising the financial/business benefits of decisions that improve energy efficiency, result in inconsistencies in capital deployment and neglect of opportunities that would be cost effective for the overall organisation. Tackling this requires measures that address senior-level commitment in an organisation.

The mix of drivers/barriers differs between different types of energy use and energy user, and therefore policy measures need to be tailored to the specific needs of the user type if the cost effective carbon abatement opportunity is to be harnessed.

ii Strengths and weaknesses of current Climate Change Programme

The current Climate Change Programme (CCP) for the business and public sectors has a number of powerful building blocks in place. The Climate Change Levy (CCL) sets a key backdrop against which the EU Emissions Trading Scheme (EU ETS) and Climate Change Agreements (CCAs) are driving change in the energy intensive industries. In addition Building Regulations and the Energy Performance of Buildings Directive (EPBD) are helping to address other sectors. However, across all of these instruments there are significant implementation issues that could limit their ultimate carbon delivery. Moreover, the current package is not providing sufficient incentive for change across the less energy intensive segments, where energy costs are less material, and where in particular the current CCL does little to drive change and structural failures persist.

- The **EU ETS** is the right basic approach for incentivising change in power generation and in energy intensive sectors while at the same time minimising competitiveness impacts. However its delivery depends upon collective allocation across the EU and it is potentially undermined in some areas by perverse incentives. The EU ETS design is specific to large industrial facilities and it does not provide a basis for addressing the rest of manufacturing or service sector emissions. *The UK needs to take a leadership role in the EU and beyond to ensure that a level playing field is created through robust pan-European allocation, and that the future of the scheme post 2012 is defined to give firms the long-term certainty they need to make investments*
- **The Climate Change Agreements (CCAs)** provide a wider set of energy-intensive sectors with an 80% rebate on the CCL if they meet agreed carbon reduction targets. CCAs create a good incentive to secure low-cost emissions reductions in the rest of energy-intensive industry outside EU ETS sectors. In addition CCAs offer insurance from a policy perspective against EU ETS price uncertainties and under-delivery. Overlap between the CCAs and the EU ETS is not problematic from an economic perspective at this stage but the overlap does create administrative burdens. However 'awareness' impacts of CCAs may be wearing off and tightening CCA targets may become increasingly difficult. If confidence grows in the EU ETS and its price stability, and a corresponding trading instrument is introduced for non-EU ETS sectors, then *CCAs need not be extended beyond their current term and the participating sectors could move into an appropriate emission cap-and-trade system whilst maintaining their CCL discount, i.e. the EU ETS or a new UK trading scheme as described in this report*
- **Building Regulations and the Energy Performance of Buildings Directive (EPBD)** can drive significant change in the UK's building stock. However, enforcement of and compliance with Building Regulations are patchy and definitions (e.g. of public buildings in the EPBD) may be restrictive. *'Part L/J inspectors' focussed on large buildings (>1000m^2) with the ability to ensure compliance with Building Regulations would make a significant difference. In addition, extending the definition of 'public buildings' within the EPBD to include all large buildings visited by the public (not just public sector buildings), moving to phased display of operational ratings across all large buildings, together with obligations on building owners to implement 'easy and cost effective' measures as identified by asset rating certificates could greatly and cost effectively increase carbon delivery across the UK*
- Increasing the **Climate Change Levy (CCL)** rate could increase carbon savings, particularly in manufacturing, but *economically acceptable CCL increases would have little impact in services energy use. Restructuring the CCL to a consumption-based carbon tax increases carbon delivery but only very slightly. Therefore a new approach to incentivising change across the less energy intensive segments is required*
- **Metering inadequacies** reduce efficiencies and impede any strengthened CCP outcomes – it is hard to manage what you can't measure. *Stronger requirements should be placed on energy suppliers to provide accurate, verifiable metering data and the coverage of half-hourly metering should be extended.*

iii Addressing gaps in the Climate Change Programme

A new instrument is required to address the big growth in service sector energy use in particular. Having investigated various routes to incentivise change in less energy intensive organisations, we conclude that a new mandatory trading scheme for large, less energy intensive organisations that fall outside the EU ETS is required. The key to such a scheme is simplicity, and the inclusion of not just direct emissions, but also electricity related emissions which constitute up to 70% of the CO_2 produced by the target sectors.

- The CCL is not a material cost and it does not address the market misalignments (e.g. tenant-landlord split) or leverage other drivers (e.g. investor, customer or employee pressure) that could overcome organisational and behavioural barriers in less energy intensive sectors. *The UK should build upon the UK ETS and the success of CCAs in terms of driving change by considering a new separate but simple mandatory, company/organisation-based emissions trading scheme, including electricity-embodied emissions and perhaps fleet haulage for large companies, which we have termed UK CETS (Consumption-based Emissions Trading Scheme)*
- The scheme would increase the transparency of energy use and emissions in less energy intensive organisations. It would be based on energy use as measured by the electricity and gas meters already in place, with results presented in a consistent fashion in annual reports, making emissions a compliance issue and requiring larger UK organisations (both public and private sector) to articulate a clear carbon management strategy
- Full auctioning of allowances would avoid gaming and transaction costs associated with allocation negotiations, and accompanying CCL rebates would prevent creating an additional financial burden for business
- This instrument has significant potential coverage. Even if initially restricted to the existing coverage of half-hourly meters, it could span baseline emissions of ~20MtC split roughly equally between less energy intensive manufacturing and the service sector, and encompass around 14,000 companies and public sector organisations (occupying 91,000 sites).

Other instruments will also be required to overcome specific barriers in the public sector and for small and medium sized enterprises (SMEs). SMEs are difficult to target cost effectively, both because of their diversity and the lack of time, resource and expertise they have to apply to these 'non-core' issues.

- **Product energy efficiency** *labelling could be extended across business and public sector-related products, and increasing product standards could be used as a highly cost-effective way to remove the least energy efficient products from the market-place. This approach would be highly cost effective for SMEs in particular.* **The Government's Enhanced Capital Allowances Scheme** (ECAs) energy technology list strongly influences product selection and manufacturers; *ECAs should be maintained and criteria for qualifying technologies regularly tightened*
- **Interest-free loans for SMEs** will also help to drive change in the SME segment, overcoming the barrier that many small firms have of inadequate access to capital
- Far stronger **Public Sector leadership** can both set a behavioural and strategic example to the private sector and leverage its large purchasing power (the public sector was responsible for one third of non-domestic new build and refurbishment in 2004). *Meeting the established target to reduce public sector carbon emissions by 12.5% by 2010 will require greatly improved governance, tighter procurement guidelines, extension of ring-fenced interest-free loans, and extension of other support mechanisms.*

'White certificate/baseline and credit' project style trading offers supplementary but limited options. These schemes require costly, complex verification and monitoring of individual projects, have lower impact as they focus largely on asset-related investments rather than behavioural opportunities and, if Government pays for the credits generated, are less cost effective than alternative approaches. Placing obligations on energy suppliers to save energy amongst their business customers, particularly small and medium sized enterprises – *'Energy Efficiency Commitment for SMEs'* – may help but delivery through such market-based routes is likely to remain modest and high-cost in this intractable market segment.

iv Quantified conclusions on cost and delivery

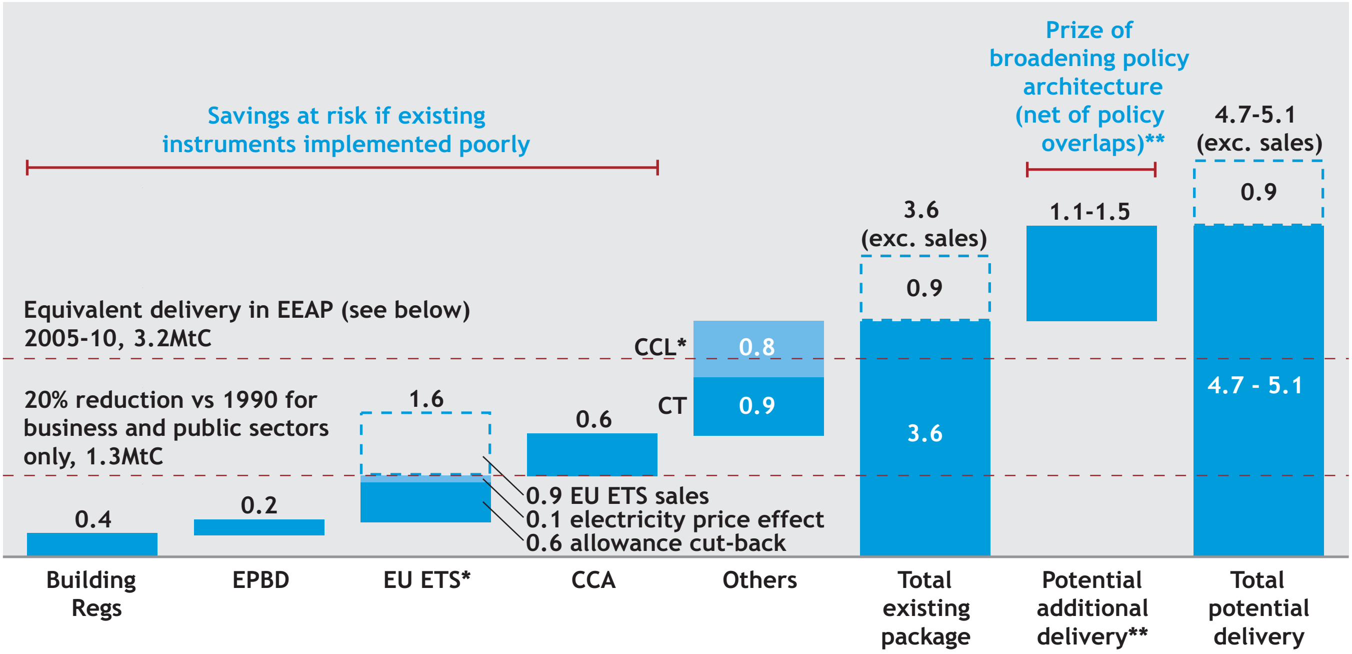
Resuming and accelerating the decline in UK CO_2 emissions is possible and need not damage UK business. We analysed various policy packages in detail using diverse methodologies to establish carbon savings, cost implications and the best mix of measures from a carbon reduction and competitiveness point of view going forward.

- Prompt implementation of our most cost-effective package of measures could reduce carbon emissions from business and public sector end use by up to ~4.7-5.1MtC p.a. by 2010 and ~11.2-12.6MtC p.a. by 2020 (about 10% and 20% respectively of projected emissions from these sectors). This would turn projected growth into an absolute decline averaging about 1%/yr. In 2020, ~9MtC p.a. of this delivery would come from the existing instruments (assuming they are fully implemented to maximise carbon savings), whilst the net prize of broadening the package of measures is an additional carbon saving of 2.2-3.6 MtC p.a. (Charts A and B). This significant additional prize is primarily driven by the proposed new UK trading scheme
- Over 90% of these savings can be achieved by technologies that deliver net cost savings at a 15% cost of capital. On this basis, a strengthened Climate Change Programme would create a significant aggregate net benefit for UK firms, saving up to £70/tCO_2 on a lifetime basis.

The overall impact of strengthening the policy measures to address climate change in the business and public sectors will have little or no impact in terms of competitiveness of UK business except potentially in a few limited cases:

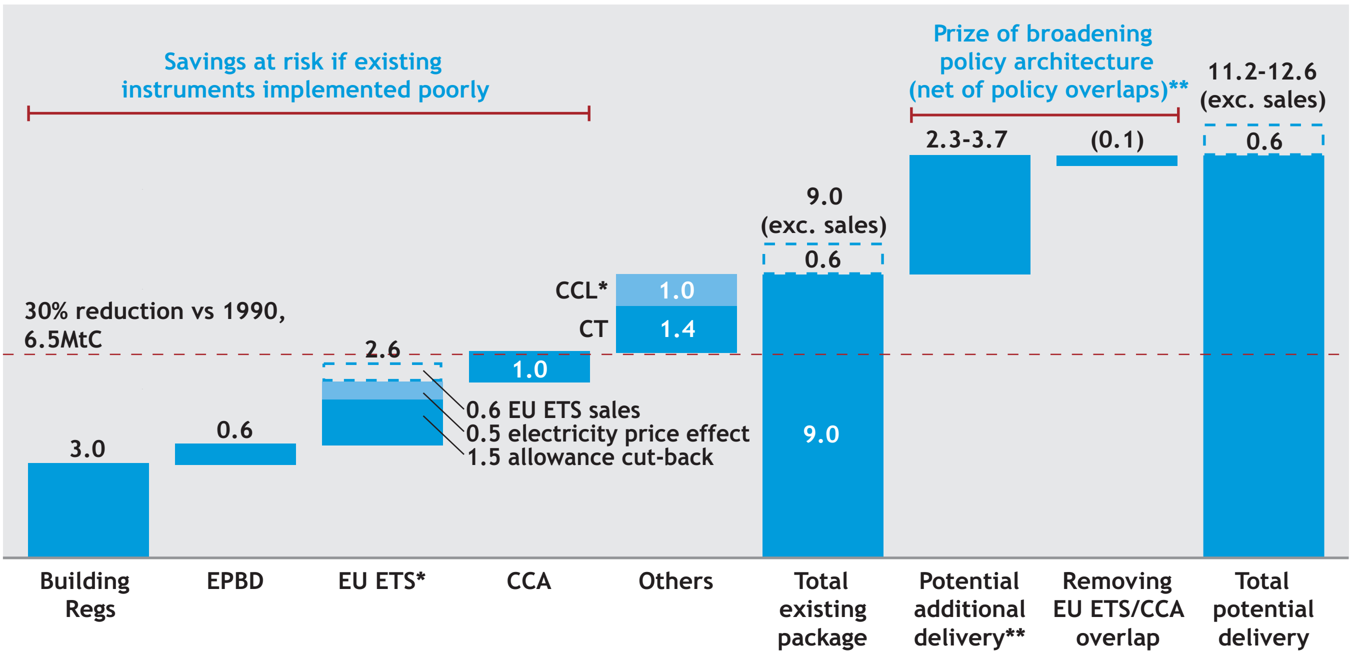
- As explained in previous studies, several of the sectors in the EU ETS have potential to profit from it due to pricing effects and the value of the free allocations they receive. The cumulative impact of the instruments modelled in this study, and separation of EU from non-EU trade, do not change this fundamental conclusion
- Despite derogations in the energy-intensive sectors, aluminium smelting could be severely impacted if purchasing electricity from the grid, and for strengthened measures beyond 2012 the steel and cement industries might justify protection against imports from regions without equivalent measures. The cost increases in other energy-intensive sectors overall would not materially affect their competitiveness, though we cannot rule out possible exposure of exceptional individual subsectors
- Outside the energy-intensive industries, the cumulative financial impact of the price-based measures in our strongest scenarios would add 1-1.5p/kWh to electricity prices by 2020. This, and any additional investment required, could be offset by efficiency gains and revenue recycling. Outside the energy-intensive sectors the net cost impacts of the policies under consideration are immaterial and many could gain
- The macroeconomic modelling studies we employed tend to confirm the carbon savings potential of pure price instruments but generate a range of conclusions about GDP impacts in particular. In our high carbon price scenarios, GDP impacts vary by +/- 0.3% by 2010 (compared to baseline projected emissions). Further work is underway to reconcile the conclusions from the two macroeconomic models used in this study.

Chart A** Carbon delivery 2005-2010 of existing package, and additional carbon prize of a strengthened package of measures MtC p.a. saving in 2010 vs. projected emissions (60MtC)*



- Base case delivery of existing package close to EEAP (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 CETS capable of delivering additional 1.1-1.5MtC

Chart B** Carbon delivery 2005-2020 of existing package, and additional carbon prize of a strengthened package of measures MtC p.a. saving in 2020 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 CETS has potential to deliver additional 2.2-3.6MtC

Note: *Savings in end-use only, excluding power sector switching, EU ETS based on market price of €15/tCO_2 in 2010, €30/tCO_2 in 2020 and 1% p.a. cutback, CCL at current strength; **Additional delivery of a strengthened package including UK Consumption-based Emissions Trading Scheme (UK CETS), net of overlap with CCL and the Carbon Trust (strengthened EPBD product standards are only additional to UK CETS in SMEs); ***Allowing for CCP delivery 2000-2005 (3MtC).
Source: Ecofys.

v Innovation and interactions

Innovation and interactions with other sectors offer the potential of additional savings, but costs could also be increased if instruments are inappropriately extended or the CCP is insufficiently broad-based.

- UK businesses, particularly energy-intensive industries, are already a prime focus of climate-change-related legislation. Strengthened action must be accompanied by equal policy attention to emissions growth in transport and the domestic sector
- A high EU ETS carbon price would drive coal to the margin of power supply and magnify the near-term carbon-value of end-use electricity efficiency. Decarbonisation of power generation over time, driven by the EU ETS and industry-building instruments like the Renewables Obligation, has the potential to reduce the knock-on price impacts of the EU ETS to electricity consumers
- Extending the EU ETS to aviation carries the risk of magnifying cost impacts on the rest of UK and European industry, if the price is to develop to a level that would significantly affect aviation emissions directly.

Implementing policies that accelerate the adoption of leading-edge efficiency technologies will also accelerate related innovation. However, additional and ongoing policy support will be required to accelerate the development of new energy efficient and low carbon technologies (which fall outside the scope of this study). The potential for end-use innovation is enormous and international data suggests that higher domestic energy prices do not in the long-run increase national energy expenditure.

1 Issues and options

1.1 Context for a carbon emission reduction strategy

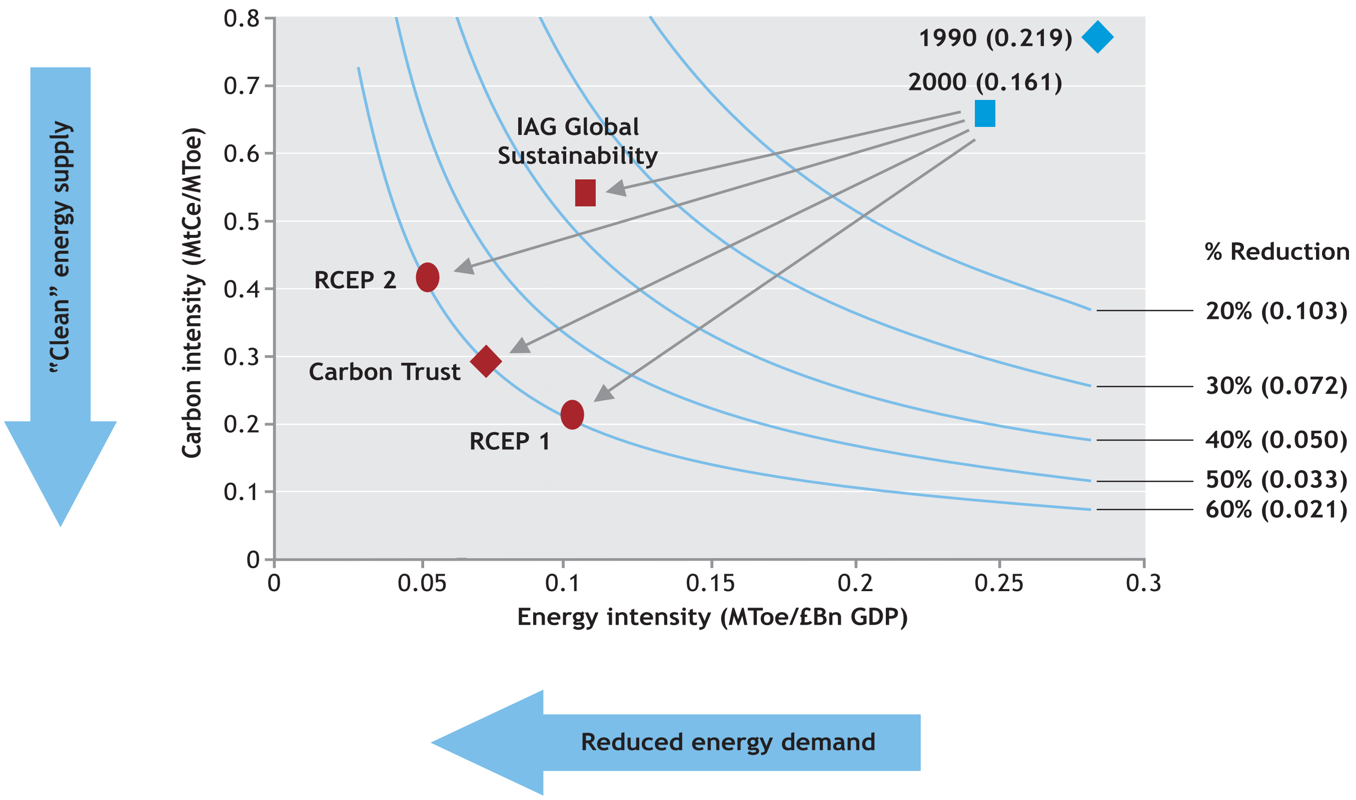
The case for energy efficiency

The 2003 UK Energy White Paper established a national goal to reduce carbon emissions by 60% by 2050, indicating the aim to achieve this primarily through a combination of energy efficiency and renewables. Supporting analysis, and interim goals set in the White Paper, indicated that energy efficiency was expected to deliver the majority of emission reductions in the short term, with the renewable energy contribution maturing over the medium to long term.

"To achieve the required savings from energy efficiency would need roughly a doubling of the rate of energy efficiency improvement seen in the past thirty years."

– Energy White Paper 2003

Chart 1 *Possible combinations of energy and carbon intensity improvements for delivering a low carbon economy in the UK*



Note: The blue lines show possible combinations of changes in energy intensity and decarbonisation of energy supplies that would deliver different percentage CO_2 reductions in emissions from 2000 levels, together with (in brackets) corresponding changes in carbon intensity (MtC/£bnGDP) for projected GDP growth by 2050. The points at top right show the UK positions for 1990 and 2000, and the scenarios/arrowed lines show 2050 projections. Source: The Carbon Trust and Imperial College, The Royal Commission on Environmental Pollution (RCEP) 1998, DTI EP68 GDP growth forecasts, the UK Government Interdepartmental Analysts Group (IAG) 'Long-term Reductions in GHG in the UK', Feb 2002.

Chart 1 shows possible combinations of improvements in both energy efficiency (national energy intensity) and decarbonisation of energy supply (carbon intensity) that could deliver such large-scale reductions, and illustrates some specific scenarios emerging from modelling work conducted by the Royal Commission on Environmental Pollution (RCEP) and the UK Interdepartmental Analysts Group (IAG) along with Carbon Trust and Imperial College analyses. These confirm that in order to reach the Energy White Paper target of a 60% reduction in CO_2 emissions by 2050, it is not enough to implement solely low carbon energy sources. Substantially improved energy efficiency is also required to put the UK on a path to achieving the required reduction – even with the most ambitious expansion of low and zero carbon supplies of energy.

Energy efficiency was targeted in the White Paper because technical assessments show that its potential is not only large, but also highly cost-effective. The PIU[1] report which preceded the Energy White Paper estimated in excess of £2.5bn/yr of cost-effective energy efficiency opportunities in UK industry and service sectors.

As part of its input to the Government's five-year review of the Climate Change Programme, the Carbon Trust has conducted an extensive analysis of how business and the public sector use energy, the potentials for improving efficiency, the barriers to this, and the options and impact of different policy packages.

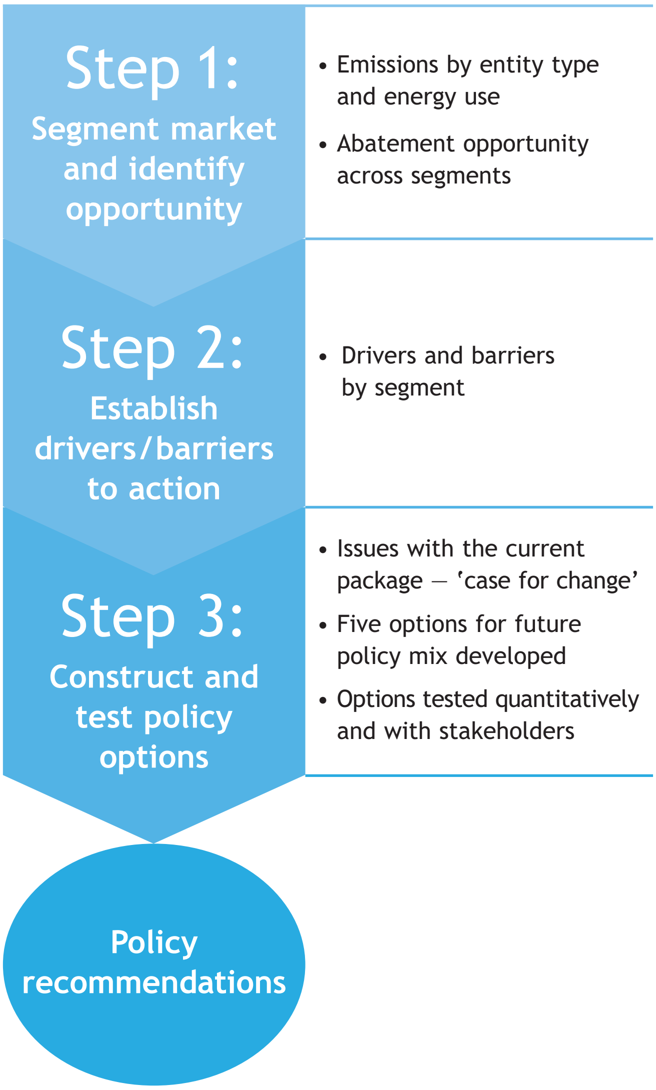
Study process overview

A sequential three-step process, shown in Chart 2, has been used to develop policy recommendations. First, current and projected emissions in the business and public sectors have been mapped across segments which have been differentiated based on their nature of business, size and characteristics of energy use. The carbon abatement opportunity by segment was then identified to understand the scale of carbon impact that policy measures could achieve cost-effectively. The barriers preventing energy efficiency measures being implemented and the drivers that could also help to bring about the required change were then investigated and mapped across the market segments. This fact base provided the grounds for the policy packages subsequently developed and tested, that essentially investigate different ways of overcoming the barriers to change and of course leveraging the drivers that can help firms take up carbon savings while maintaining or improving competitiveness.

As described in later sections of this report we used four separate models to analyse the impact of the policy architectures developed. These looked at three different impacts: (1) cost and scale of carbon delivery, sector by sector, using bottom-up abatement curves; (2) competitiveness impacts using microeconomic analysis of selected sectors; and (3) carbon and GDP impacts for the UK economy as a whole using macro-economic models.

A series of five stakeholder workshops were also held to gather the views and reactions of business, the public sector, non-governmental organisations (NGOs) and the suppliers and manufacturers of energy-efficient equipment to both our analysis and to potential policy options.

***Chart 2** Study methodology*



Modelling work:

- Carbon delivery, Ecofys
- Competitiveness, Oxera
- Macro-economic effects, Oxford Economic Forecasting and Cambridge Econometrics

Stakeholder workshops:

- Energy-intensive sectors
- Non-energy-intensive sectors (hosted by CBI)
- Public sector
- NGOs
- Suppliers of energy-efficient equipment

[1] Performance and Innovation Unit, *The Energy Review 2002*.

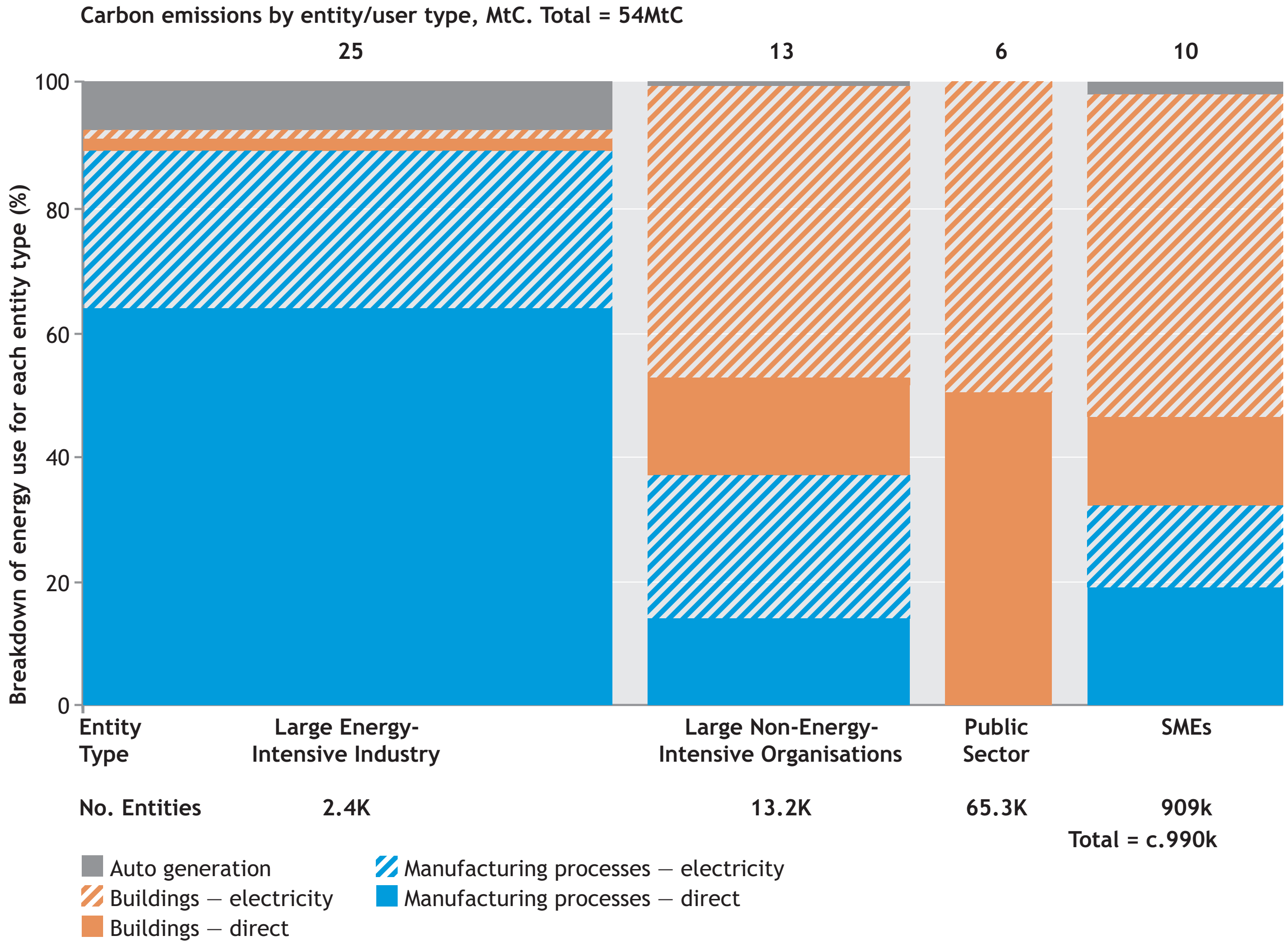
Overview of carbon emissions from business and public sectors

Energy efficiency policies and programmes need to be founded on an understanding of the current and projected structure of energy demand. Of the UK's overall carbon emissions of ~150MtC p.a. (excluding air transport and GHGs other than CO_2), ~54MtC comes from the business and public sectors (including the attributed portion of power generation emissions). As Chart 3 illustrates, this can be split into four categories or 'entity/user types':

- Large energy-intensive users, which we have defined as sectors for which more than a third of their emissions are covered by either the EU Emissions Trading Scheme or the UK's Climate Change Agreements, both of which have been targeted at energy-intensive sectors (size cut-off applied of >50 employees in manufacturing sectors)
- Large non-energy-intensive users, which covers both low energy-intensive manufacturing and the larger service sector organisations (size cut-off applied of >50 employees in manufacturing sectors and >250 employees in service sectors)
- Public sector, covering all the Government estates including; e.g. education, hospitals, local government, etc
- Small and medium-sized enterprises (SMEs), defined here as companies with less than 50 employees in manufacturing sectors or 250 employees in service sectors – almost a million legal entities in total.

As illustrated in Chart 3, the first category accounted for about 45% of the total business and public sector carbon emissions in 2002. Large non-intensive companies were the next largest segment, followed by SMEs and the public sector respectively. Out of a total of almost a million organisations, 90% are SMEs, followed by public sector (65,000), large non-energy-intensive organisations (13,000) and only 2,400 companies in the large energy-intensive sector.

Chart 3 UK business and public sector carbon emission by energy use and entity type (2002)



Note: For definition of entity type see text. Direct emissions are CO_2 emissions from gas, oil and coal consumption including those used for direct process conversion (e.g. in cement and steel). Building emissions include appliances, computers etc.
Source: The Carbon Trust and Ecofys.

Chart 3 also illustrates the split between emissions attributable to manufacturing process operations, and those associated with building occupancy including heating, lighting, refrigeration, and 'plug-in' loads such as computers. Although across the total, manufacturing process operations account for around 56% of CO_2 emissions, this is entirely due to their dominance in large energy-intensive operations; in the other sectors, buildings-related emissions account for at least two-thirds of the sector emissions. The hatched areas in the chart also show that the carbon emissions from building energy use are dominated by the indirect emissions associated with their electricity consumption.

> "Final consumption of electricity rose by 2.0 per cent in 2004 compared with 2003. Consumption by the domestic sector was up by 1.6 per cent, and by commercial, public administration, transport and agricultural customers was up 2.0 per cent, while industrial use of electricity rose by 2.4 per cent."
>
> Source: DTI, Digest of UK Energy Statistics

Recently surging electricity demand, not least in the business and public sectors, threatens the UK's near and mid-term emission reduction goals. The potential to tackle this, most of all in building energy use, emerges as a major part of the potential for emissions abatement. The service sector in particular is growing, with latest DTI projections implying an expected 20% increase in its emissions by 2020. The majority of this increase will be associated with buildings use.

Where is the potential for carbon abatement?

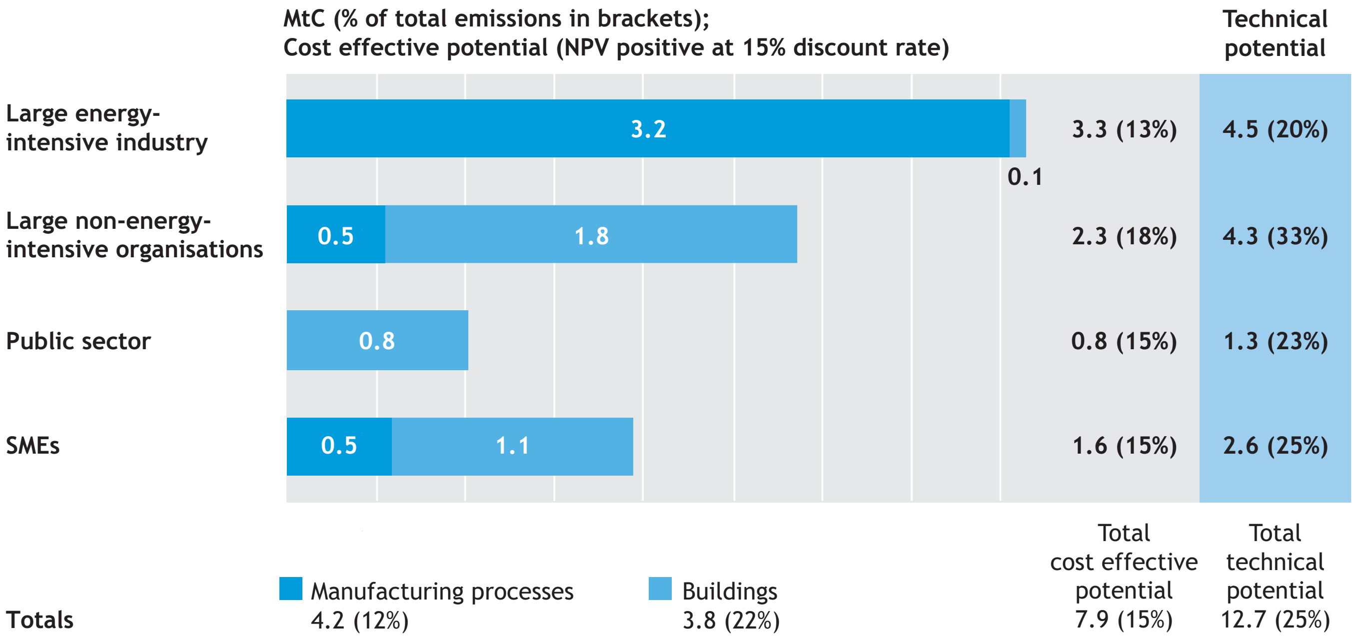
The second step in our analysis involved assessing the potential for abatement, on the basis of technology-based abatement cost curves.

The resulting opportunities, in terms of technical and cost-effective potential savings opportunities, are illustrated in Chart 4. Manufacturing processes in the large energy-intensive users do still have the greatest overall potential to reduce carbon emissions, but in percentage terms the opportunities are bigger elsewhere.

These technology-based assessments show that outside the energy-intensive industries, the largest potential for cost-effective abatement (i.e. changes that deliver economic benefits as well as emission reductions) lies in buildings-related energy use. It is also notable that these are the sectors of most rapid projected growth. Tackling climate change cost-effectively, in other words, means tackling the reasons why companies and people waste so much energy particularly in the buildings they occupy.

Given the abatement opportunities, creating the business case for energy efficiency investments ought to be relatively simple. There are a wealth of energy-efficient technologies on the market which offer energy savings that result in attractive paybacks. The key question is why the take-up of energy-efficient technologies is so slow when it appears so attractive. More fundamentally, the key to effective policy on energy efficiency is to understand in depth what factors drive, and what factors impede, changes in investment or other behaviour towards more energy-efficient choices.

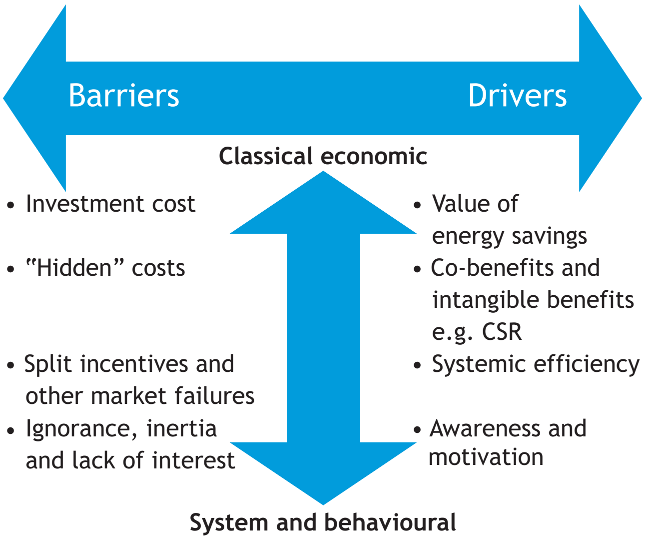
Chart 4 *Carbon abatement opportunity by 2020: cost-effective (@15% discount rate) and identified technical potentials by energy use and entity type*



Note: Carbon saving opportunity is based on detailed sector-level source data (ENUSIM and BRE abatement curves), providing a measure-by-measure breakdown of abatement opportunities using existing technologies and their cost implications (buildings figures based on opportunity in existing stock only). Cost effective opportunity is defined as one that has a positive Net-Present-Value (NPV) at a 15% discount rate; full technical potential includes all measures in the abatement curves. Opportunity as stated does not allow for innovation and introduction of new technologies between now and 2020 (which would be expected to significantly increase the figures shown).
Source: Ecofys: ENUSIM abatement curves and BRE buildings measures abatement curves.

1.2 Drivers for and barriers to energy efficiency uptake

Chart 5 *Barriers to and drivers for energy efficiency uptake*



Source: The Carbon Trust.

To date most studies have focused on listing barriers, rather than looking at their common roots and at what drives business change. From a business perspective, understanding what drives change is just as important as understanding the barriers. Our analysis sets these alongside each other and concludes that both barriers and drivers fall into four main categories, as summarised in Chart 5. These are described in more detail in Chart 6, together with the policy options that can be used to leverage/overcome the drivers and barriers.

i. Investment and returns: financial cost/benefit

The first category is the straightforward financial calculation, in which required additional investment is the main barrier and the financial value of reduced energy consumption is the main driver. This encapsulates the most simple view of business decision-making, that it is a rational trade-off based purely on financial criteria. The associated policy levers are equally simple: increasing energy efficiency requires either reducing the up-front cost of more efficient technologies, or increasing energy prices to the users.

The first question is thus. Whether prices are right – and in particular, whether energy prices fully reflect environmental damage, systemic risks or other 'external' costs. Where they do not, there is a *prima facie* economic case for correcting this with economic instruments such as taxes and/or emission trading systems. Unfortunately, getting energy prices 'right' through such measures is politically hard and faces huge uncertainties; and in terms of energy efficiency, it may not even be addressing the most important driver/barrier across all sectors.

For energy-intensive sectors, in which energy is a major part of operating costs, the financial cost-benefit balance may well be a primary consideration. In most sectors however, other factors are more important.

ii. Hidden costs, intangible benefits: expanded cost-benefit

The second broad category are costs and benefits that are real, but are not captured directly in financial flows. For example, if more efficient equipment is more advanced but less reliable, or is harder to get serviced, that is a real cost to the user. If new lightbulbs or motors do not fit in the old sockets or frames, that is a real albeit transitional cost. Also, if simply evaluating the options of more efficient equipment or practices takes additional time and attention of senior management, that is a real cost; the same is true of other potential 'transaction' costs of negotiating deals on more efficient equipment.

Conversely, benefits that are real but less tangible than direct money savings may be important drivers. Benefits of more energy-efficient investment may include reduced exposure to future energy price volatility, or the 'Corporate Social Responsibility' benefits associated with being seen to act responsibly in respect of environmental impacts, for example in terms of 'green' consumers, 'ethical' financial institutions or employees.

Hidden costs and intangible benefits are complex and diverse with correspondingly complex policy implications. Some forms of hidden costs may be inescapable and enduring. Others may be transitional, so that if policy drives businesses to make more efficient purchases once, this becomes the least-cost default in subsequent decisions. Others still may be entirely policy-dependent, for example if transaction costs are a principal barrier, an obvious solution is product standards that simply outlaw inefficient equipment – everyone then avoids the time and hassle of working out what bad purchases to avoid. Mandating clear information and labelling may be an intermediate solution, vastly reducing the cost to users of finding out about the energy performance of potential purchases.

Lack of adequate skills may similarly raise barriers. Organisations are often unwilling to take on the risks of installing new technology with which they are unfamiliar, particularly if they perceive any risk of compromising the running of core operations. Policy measures to overcome this barrier are likely to include services providing information or technical support, packaged energy contracts or, most bluntly, standards that mandate use of a minimum energy performance.

***Chart 6** Barrier/driver categories and related policy options*

Category	Definition	Examples	Policy options
Financial cost/benefit	Ratio of investment cost to value of energy savings	• More expensive but more efficient equipment • Other financial co-benefits or co-costs of new equipment (e.g. improved control, etc.)	• Economic instruments that reduce equipment cost or finance cost, or increase energy prices
Expanded cost/benefit (intangible, transaction and transition costs)	Cost or risk (real or perceived) of moving (or not moving) to more energy-efficient practices including managerial, information, risk and decision-making requirements, not captured in a standard cost/benefit	• Costs and risks of change — Incompatibility — Performance risk — Management time — Other transaction costs • Exposure of not changing — Higher emissions risk — Equipment obsolescence — Customer/employee pressure	• Services providing information and technical support • Packaged energy service contracts • Standards requiring use of a particular technology/solution, e.g. product standards, etc. to avoid transaction costs
Market misalignment (split incentives, system failures regulatory failures)	Market structure and constraints that prevent the consistent trade-off between specific energy-efficient investment and the societal energy-saving benefits	• Landlord/tenant split • Regulatory failures e.g. in electricity metering • First-mover costs and risks • Externally-imposed budget constraints	• Contractual or market organisation solutions to split incentives between organisations • Product standards • Capital market solutions (e.g. public sector financing scheme) • Public support of first-mover costs
Behaviour and motivation (inertia, awareness, materiality)	Internal issues of firm behaviour linked to awareness, motivation and internal organisation	• Organisational failures (e.g. internal split incentives) • Inertia, rules of thumb • Tendency to ignore small opportunities	• Campaigns and sector learning networks • 'Attention raising' instruments: e.g. trading; CCAs with sector targets and 'cliff' incentives (tax exemption) • ECA lists and low interest loans available to equipment purchasers in organisations

Source: The Carbon Trust.

Policies that create increased transparency and awareness can be used to leverage intangible benefits such as 'Corporate Social Responsibility'. An example is a trading scheme linked to clear financial reporting guidelines, acting as an awareness-raising scheme that makes emissions reduction a compliance issue, as much as an economic incentive for change.

iii. Split incentives, system and regulatory failures: market misalignment

The third category of drivers and barriers lies where market structures prevent the benefits of an investment accruing to the organisation concerned. Conversely, the associated driver would be anything that helps 'external' benefits (i.e. benefits to society) accrue to those undertaking related actions.

The classic example of this barrier is the tenant–landlord split, which is particularly prevalent in commercial buildings where companies rarely own their premises, and have no direct control over the structural performance of the building. But they pay the energy bills, so the building owner has no incentive to undertake energy efficiency investments.

There are many other examples of such split incentives. In most countries, electricity supply companies are responsible for meters installed in premises, but have no direct interest in (and may indeed lose out from) advanced metering that would enable their customers to better monitor and control their usage.

More generally, innovative investments may generate large societal benefits through the learning acquired, but it may often be hard for a given company to benefit from this directly. The majority may well hold back, waiting for someone else to pay for the 'field testing' that is a key part of establishing better technologies at a commercial scale. The hope of establishing a market-leading position can be an important driver; but in general the result is persistent under investment in innovative solutions.

A final, pervasive area of such failure is in capital availability — or lack thereof — when it is imposed from outside. For example, budgetary constraints imposed on some public sector organisations, which mean they lack the capital to undertake even investments that would yield net savings within just a couple of years.

Policy measures to overcome this barrier are likely to be contractual or market organisation solutions to split incentives between organisations, standards, or explicit capital market solutions; one example is the Salix fund established by the Carbon Trust to support public sector energy efficiency investments by providing ring-fenced loan funding for Net Present Value (NPV) positive energy efficiency projects. More often, however, 'lack of capital' for such investments reflects the fourth and final barrier — the realities of how most organisations actually behave in relation to non-core investment.

iv. Inertia, awareness and materiality: behaviour and motivation

The final area of barriers and drivers concerns the many ways in which organisational behaviour differs from the theoretical ideal of consistent, rational decision-making that maximises company profits.

This is generally reflected in a mix of 'internal split incentives' and simple payback criteria. In many organisations, the person making relevant decisions — for example, the engineer responsible for upgrading or replacing motor drives, or an IT equipment manager — may have no interest in the energy consumption of the product, for example they may be more concerned about the upfront cost or the devices reliability, and would gain nothing from installing more efficient devices.

From an economic point of view, energy efficiency investments should compete against alternative capital projects on a 'rate of return' basis. But energy efficiency is rarely core to a company's strategy; it may reduce costs, but even this may be modest compared to more radical measures such as staff reduction or relocation of production facilities. Managers rarely have ring-fenced budgets dedicated to energy efficiency and a lack of prioritisation at this level is also a significant barrier. As a result, even in organisations that may be sophisticated in core business evaluation, energy-related choices may be relegated to simple payback criteria, or even just taken on the basis of lowest upfront cost. Distrust of the energy savings that can be captured from unfamiliar equipment — or inability to monitor it due to inadequate metering — also leads to a risk-averse attitude amongst decision-makers. Because energy costs are often not material to many companies' competitive position, the incentives to sort out such organisational inefficiencies are minimal.

A striking example of the opportunities was BP's experience after deciding to address its own CO_2 emissions by reducing internal energy wastage — a programme which BP estimate ended up saving around £600m/yr in reducing the company's CO_2 emissions by around 10%.

Few companies operate at such a scale but the principle is the same. Energy consumption is rarely core business and all kinds of internal inefficiencies fester as a result. The key issues with addressing this barrier revolve around lack of awareness, motivation and often indifference to taking action. The principal solutions, short of direct regulation, are twofold: to get help directly to energy decision-makers within firms — for example with technical or targeted financial assistance; and to use levers — such as campaigns, harnessing sector networks, and 'attention raising' instruments — that raise awareness and motivate senior managers to sort out the internal organisational failures that dominate this issue, not least in respect of how companies use energy in their buildings.

Chart 7 *Mapping barriers/drivers against energy use and entity type – barriers in bold are most important*

	Large energy-intensive industry	Large non-energy-intensive organisations	Public sector	SMEs
Building energy use	• Financial C/B • Expanded C/B • Market misalignment • **Behaviour and motivation**	• Financial C/B • Expanded C/B • **Market misalignment** • Behaviour and motivation		• Financial C/B • Expanded C/B • Market misalignment • **Behaviour and motivation**
Manufacturing processes energy use	• **Financial C/B** • Expanded C/B • Market misalignment • Behaviour and motivation	• Financial C/B • Expanded C/B • Market misalignment • **Behaviour and motivation**	• **n/a**	• **Financial C/B** • Expanded C/B • Market misalignment • Behaviour and motivation

In buildings energy use, main driver/barrier differs by market segment but is ***not* financial cost benefit (C/B)**

In manufacturing energy use, **financial cost benefit (C/B) is important. Other costs and barriers matter too**

Issues of behaviour and motivation (and how they affect internal organisation) are significant and sometimes dominant for all large organisations

A generic barrier across all SME energy use is non-financial costs, particularly **transaction costs**

Source: The Carbon Trust.

Mapping drivers and barriers

The relevant drivers and barriers set out here do not apply uniformly across the different sectors, nor indeed the different types of energy use. Chart 7, derived by aggregating the results of various market surveys, maps the relative importance of the different driver/barriers against the market segmentations introduced in Chart 3. This keeps the distinction between process-related and buildings-related energy use, because the same entities may treat these two differently and they may not even be subject to the same incentives: generally, an energy-intensive company may pay attention to the energy use in its process equipment, for which it is responsible, but still be relatively ignorant about the energy used by the buildings it occupies, which may indeed be rented and beyond the reach of the company to influence.

Two main patterns emerge of importance for policy. In terms of energy use types, the evidence suggests that financial cost/benefit is a significant consideration but by far from the only one. Issues of expanded cost/benefit are also often important and take a variety of forms: on the cost side, the difficulty and potential cost of switching to new production methods and the transaction costs of evaluating new options; on the driver side, the fact that new more energy-efficient processes are often also more modern and have better production control technologies in many dimensions. In many cases, the idea that energy efficiency has to be traded off against other attributes is the reverse of reality – but switching to better processes may still not be easy. Behavioural realities may also be important in determining whether or not companies improve the efficiency of their manufacturing processes energy use – but, along with the split incentives of renting property, they really come to the fore in respect of buildings-related energy use, as analysed more fully in Section 2.3.

In terms of the different market segments, the large energy-intensive industries pay greatest attention to financial cost/benefit considerations – though even in this segment, the experience of Climate Change Agreements has shown considerable room for improvement. But issues of market misalignment and organisational structures dominate for the large non-energy intensives and the public sector. For SMEs, transaction costs, hidden costs and lack of skills and management time are major factors which limit the ability of companies to manage their energy.

1.3 The current Climate Change Programme

Current instruments for business and public sector

Climate change policy in the UK is not new. The present review reflects a commitment to learn from the experience of the first five years since November 2000 when the Government introduced the major package of measures that have formed the core of the Climate Change Programme (CCP) so far. In the business and the public sector, the Programme includes:

- The Climate Change Levy (CCL), a 'downstream' tax on energy use in the business and public sector (designed to be revenue neutral through corresponding reductions in National Insurance Contributions)
- Emissions trading, with the UK ETS pilot scheme now being superceded by the much more far-reaching EU ETS
- The Climate Change Agreements (CCAs), emission targets negotiated by 44 sector associations and applied to companies in those sectors in return for an 80% rebate of the CCL
- Building regulations, soon to be complemented by the EU Energy Performance of Buildings Directive
- The Carbon Trust package of support measures.

These instruments, and some of the key issues surrounding them, are summarised in Table 1.

Renewable Obligation Certificates and other mechanisms being directed specifically at electricity generation and CHP fall outside the scope of this study. In considering options for development of the Programme, in addition to wholly new measures, we consider the extension of measures currently applied to the domestic sector (such as the Energy Efficiency Commitments and product energy efficiency standards) into the business and public sectors.

The introduction of the EU Emissions Trading Scheme has a fundamental impact on the policy landscape. Its core coverage applies to all power generation, all thermal facilities exceeding 20MWth, and the key heavy industry sectors of steel, cement, pulp and paper, glass and ceramics, and refining. These represent about half of the emissions from the 'energy-intensive industries' segment in our analysis; the majority of the remainder is covered by the Climate Change Agreements (see Appendix for detailed sector breakdown).

The rest of the market is covered by the Climate Change Levy, together with building standards. The support measures provided by the Carbon Trust are supplied to both the business and public sectors. Chart 8 illustrates the current coverage of the instruments in the CCP against our mapping of energy use and entity/user types.

It is no accident that the energy-intensive sectors are protected from the full weight of the CCL by the CCAs and the EU ETS. Since they are energy intensive, the full CCL would represent a considerable cost to these companies, many of whom moreover operate in internationally competitive markets and thus could not realistically pass on the full costs. The CCAs, and the EU ETS, are designed to ensure that such companies still face a real incentive to limit emissions, but without the wholesale financial transfer to Government that would arise from a tax.

This and the existence of the EU ETS also make it unattractive to consider a carbon tax applied 'upstream', to power generators. It is notable that no country has introduced a blanket carbon tax – those that have used carbon taxation have introduced a range of exemptions – and it is even less appropriate now given the EU ETS. The option remains to reform the CCL into a 'downstream' carbon tax, in which the tax rates are weighted according to carbon content of the fuels. This would appear to be a natural development from an environmental perspective, though our modelling studies indicate that this has very little impact on business and public sector emissions. This is because the opportunities for businesses to switch between fuels in response to the carbon differentiation between coal, gas and electricity are in fact extremely limited.

For these reasons we do not consider a 'carbon tax' as a separate option for reform, but rather refer to 'CCL/CCTax'. Continuation of the Climate Change Levy, or its evolution into a Consumption-based Carbon-weighted tax are roughly equivalent instruments that do not justify further separate analysis.

The case and criteria for reform

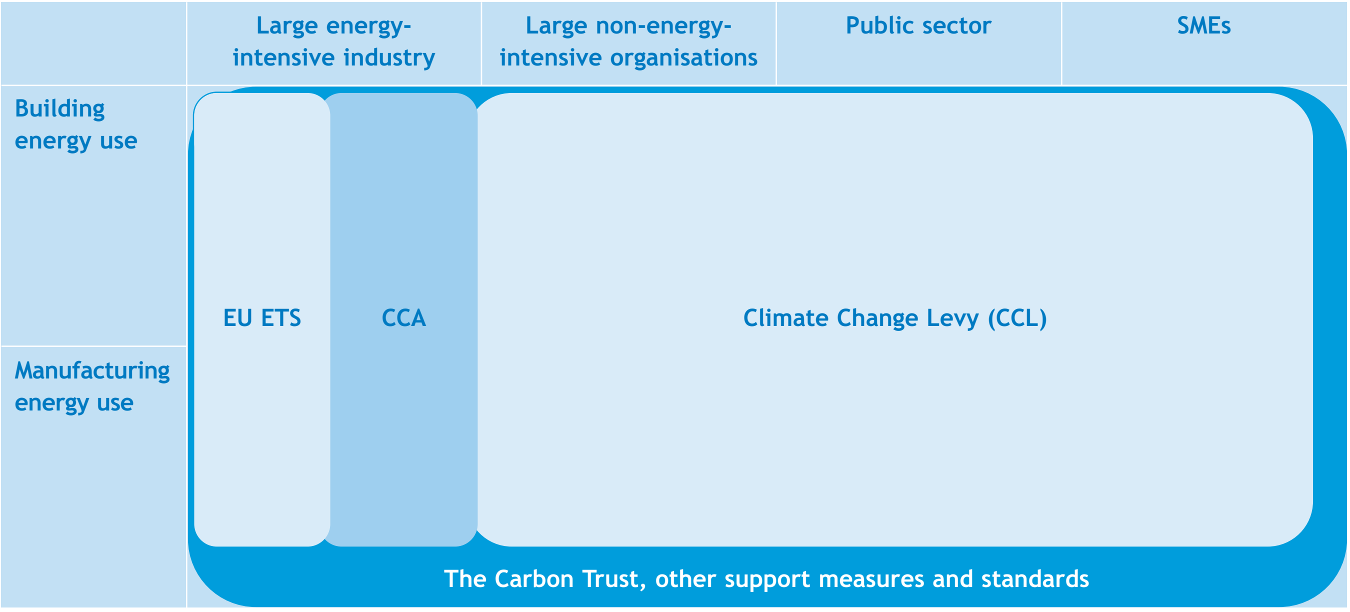
Several factors motivate the review of the CCP. One is the intrinsic desirability of taking stock and reviewing lessons learned from the first five years of experience particularly with the package of economics-related instruments. Second, the introduction of the EU ETS – which helps to solve the core problem of addressing emissions from energy-intensive industries without compromising their competitiveness in Europe – fundamentally alters the landscape and requires the role of other instruments to be assessed in relation to it. Third, is the uncomfortable fact that, after a decade of decline, UK CO_2 emissions appear to be on the rise again, underlining the need for a strengthened overall Programme if the objectives set out in the UK Energy White Paper, including the delivery of domestic and international targets, are to be achieved. Finally, the CCP measures have not (until now) been subject to a comprehensive review of, for example, their adequacy, their interactions and relative cost-effectiveness. Hence the review, and the set of studies set out in this report as a contribution to it.

Table 1 *Current business and public sector instruments in the UK Climate Change Programme*

Instrument	Description	Targeted emissions	Issues
Climate Change Levy	End-user tax on all non-domestic energy use (gas and coal: 0.15p/KWh (~£30/tC and ~£17/tC respectively), electricity: 0.43p/kWh (~£39/tC)) Companies in EU ETS or with CCA agreements that meet their targets rebated 80% of CCL (see separate instrument profiles)	All non-domestic energy use	**Materiality** – price effect may not be significant for low energy-intensive companies **Administrative complexity** – exemption and derogations make scheme more complex to administer **Lack of carbon-weighting** – weighted by energy not emissions
EU Emissions Trading Scheme	EU-wide cap and trade scheme for direct emissions from energy-intensive facilities. Phase 1 2005-7; Phase 2 2008-12; subsequent phases tbd UK Government sets national allocation plan (phase 1 sector caps based on projected emissions) Participants rebated 80% of CCL	Power production, cement man., iron and steel, pulp and paper, refineries, glass and ceramics, all >20MWth: ~46% of UK CO_2 source emissions	**Allocation principles** – using business as usual projected emissions leads to complexity and potential gaming/lobbying; **Double regulation** – overlap with CCA targets and CCL (due to indirect effect on electricity prices) **Price instability and duration.** Complex market behaviour makes price uncertain, currently only designed out to 2012
Climate Change Agreements	80% discount on CCL for participating facilities which meet negotiated energy efficiency targets Target set at sector level through negotiation with trade bodies, who then distribute targets (absolute or specific) to companies Companies can buy credits on the UK ETS in order to meet their targets	Energy-intensive-industry – through 44 sector agreements	**Complexity and double regulation** – extensive negotiations, some overlap with EU ETS **Non-participating sectors** – question over whether useful model to extend to low-energy intensity sectors and SMEs **Length of targets** – currently run only to 2011; industry lobbying for extension to increase certainty for investments
The Carbon Trust **And Enhanced Capital Allowances**	The Carbon Trust supports business and public sector delivery. It invests in and supports low carbon technologies, and near term carbon abatement activities include carbon management/customised services, on-site energy surveys, design advice for buildings, helpline, website, publications, events and loans for SMEs The Carbon Trust also administers the technology list for the Government Enhanced Capital Allowance scheme (100% tax depreciation on qualifying technologies)	Business and public sector emissions	**Overlap and attribution** – activities are key to enabling change required by other instruments **Innovation** – predicting impact of investment in future technologies is difficult
UK Pilot Emissions Trading Scheme	UK pilot incentivised trading scheme, with companies bidding in targets to secure financing, with multiple aims of abatement; trading experience; and establishing London as emissions trading centre Voluntary scheme running 2002-6, 31 direct participants agreed a 4MtCO_2e p.a. 2006 target vs. historic emissions for £215m in incentives	31 direct participants have baseline emissions of 27.8MtCO_2e (7.6MtC) – 2006 target corresponds to 13% reduction vs. baseline	**Small coverage** – participating companies represent small fraction of UK emissions **Lack of scarcity*** – substantial overachievement in first two years of scheme depressed price to transaction cost ~£2/tCO_2e: Total delivery = 9.8MtCO_2e; target = 2.3MtCO_2e; net sales to CCA sectors = 1.0MtCO_2e; banked emissions = 6.5MtCO_2e **Public Cost** – cost to Government makes it unlikely that scheme will be extended

*Some company targets have subsequently been revised to increase scarcity. Source: The Carbon Trust. Reports for the Government that underpin analysis of experience from the first five years of the UK Climate Change Programme (for example, concerning the over-delivery of the pilot UK ETS and UK CCA instruments) can be found on the DEFRA website www.defra.gov.uk/environment/climatechange/index.htm

Chart 8 *Coverage of instruments in current Climate Change Programme*



- EU ETS and CCA focused on large energy-intensive industry
- CCL is only economic instrument acting upon remaining sectors
- The Carbon Trust, other support measures and standards (e.g. Building Regulations) used across all segments.

Source: The Carbon Trust.

Climate change policy design is multifaceted and there is no clear single criteria for reform. We conducted our numerical analysis with respect to three quantitative criteria:

- Carbon delivery
- Cost-effectiveness from the perspective of both firms ('bottom up' life cycle analysis) and the country ('top down' GDP analysis)
- Competitiveness implications.

In addition, we reviewed options with respect to three qualitative criteria aimed to develop business-friendly measures:

- Do-ability
- Simplicity
- Long-term certainty.

These basic criteria do imply certain broad design principles. To maximise both carbon delivery and cost-effectiveness, instruments need to cover all the main market segments and principal types of energy use; and to the extent possible, they need to address the *main* drivers/barriers in each segment just once to avoid unnecessary duplication. Ideally, one would seek to apply the instruments with a strength that leads towards cost comparability across the different segments. Since both companies and the Government can also engage in international trading, respectively under the EU ETS and the Kyoto Protocol, an additional target of national policy could be to make appropriate use of these instruments, seeking to make sure UK industry engages in the international investment opportunities whilst trying to minimise the level of inter-governmental purchase, or even better, to profit from sales of surplus national allowances if the UK exceeds its Kyoto first period target.

Part 2 of this report sets out the main analysis, including a description of potential new instruments to address major gaps and the development of five 'archetypal packages' for quantitative assessment. Part 3 then presents the integrated results and analysis with respect to both the quantitative and qualitative criteria.

2 Analysing the options

2.1 Approach to analysis

Framework of analysis

The basic aim of our study is to understand the potential for different policy instruments to contribute to reducing carbon emissions from business and public sector energy use, associated impacts on cost and competitiveness, and the implications for possible packages of reform for the Climate Change Programme.

Our approach is based around the emissions mapping chart and analysis of barriers/drivers described in Part 1. This part of the report analyses the instrument options of greatest relevance to the main target groups and types of energy use, as indicated in the mapping of Chart 9.

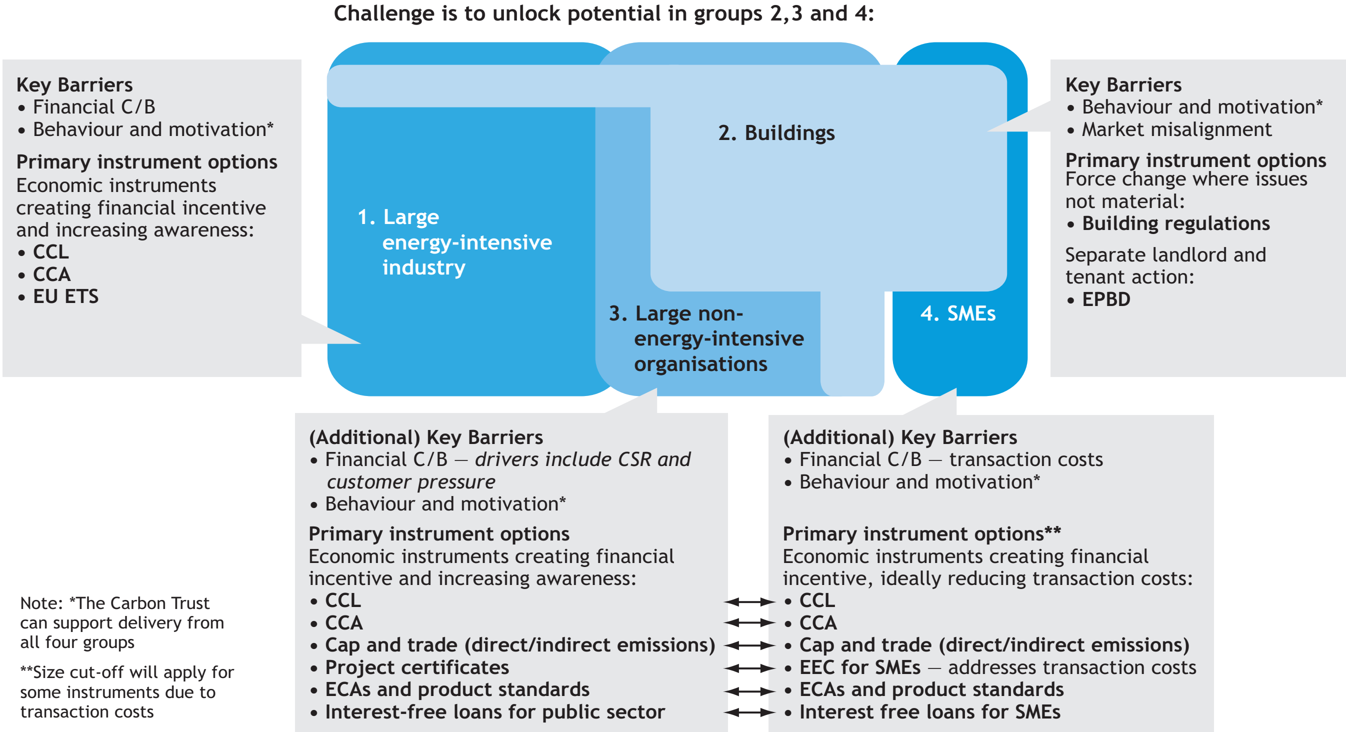
We first (in Section 2.2 of this part of the report) analyse the economic instruments which are designed primarily to impact upon the financial cost/benefit barrier/driver. These instruments have greatest direct impact on the first category, of large energy-intensive industries, though one of the main instruments in this category, the Climate Change Levy, operates across all sectors.

We then (in Section 2.3 of the report) look in detail at instruments that act directly on the energy performance of buildings such as efficiency standards and information programmes. Such energy use forms an important part of that arising from both large non-energy-intensive companies and small and medium-sized entities, and accounts for nearly all public sector energy use.

Finally, we consider (in Section 2.4 of the report) options that focus on the other aspects of how companies – particularly large companies outside energy-intensive sectors – use energy, whether through the way they use their buildings and equipment, or through the non-building aspects of their energy use such as manufacturing processes. We also consider options that address emissions from small organisations, including the possibility of placing the incentive for change on electricity suppliers, to avoid burdening SMEs with transaction costs.

Chart 9 *Market segmentation for purposes of instrumental analysis*

Mapping policy segments to key barriers that need to be overcome



Source: The Carbon Trust.

The models

To carry out quantitative analysis, we draw upon the insights from four different computer modelling systems operated by consultants to this study:

- 'Bottom-up' technology models of the industry *(ENUSIM)*, public and building *(BRE)* sectors, operated by *Ecofys*. These simulate the take-up of different technologies over time using engineering-based abatement curves provided by *Enviros*
- Competitiveness model of particular sectors (described below), with a separate model of the UK electricity sector, operated by *Oxera*
- Macro-econometric model of the UK economy, based upon econometric interpretation of past data on UK energy and economy trends, operated by *Cambridge Econometrics (CE)*
- General equilibrium model of the UK economy, based upon classical economic production function theories, operated by *Oxford Economic Forecasting (OEF)*.

Different models are appropriate to different types of questions. Broadly, the two 'whole economy' models are appropriate to give insight particularly into the aggregated impact of price-based instruments; they offer an ability to contrast very different methodologies, and also to test the impact at a macro level of integrating electricity production and potential awareness-type effects with a macro-economic framework (CE). The bottom-up model, in contrast, can address more specific measures such as building and product standards, simulating how they might affect the uptake of technical opportunities identified in the abatement cost curves. The competitiveness model focuses upon the potential exposure of particular sectors under different price scenarios. We use each as appropriate to consider specific instruments in this part of the study, and then seek to compare and integrate their insights in drawing overall conclusions about packages of measures in Part 3 of this report.

Energy and carbon price scenarios and price impacts

In all our scenarios, the non-CCP-related assumptions concerning energy prices, economic growth, etc. are taken from the DTI Updated Energy Projections published in November 2004. Recent energy price rises have exceeded these projections, a trend which if maintained would increase the cost-effectiveness of the packages we analyse since the returns on energy efficiency investments would be greater.

Two economic instruments determine the background 'carbon price' in the UK: the CCL (including its possible re-weighting to a carbon consumption tax), and the EU ETS. Table 2 indicates how the costs of the current CCL compare in carbon terms to EU ETS prices.

In our 'high' scenarios we examine the impact of doubling the CCL/CCTax from its current level, and of an EU ETS price that rises linearly from €15/tCO_2 in 2010 to €30/tCO_2 in 2020. We also consider low scenarios with each of these halved. For analysis out to 2010 we also consider a variant in which the EU ETS maintains at €15/tCO_2 to 2007 and jumps to €25/tCO_2 from 2008. Table 3 summarises the price scenarios and their overall impacts on electricity prices, which tend to be the main cost impact for most organisations.

An EU ETS price of around €30/tCO_2 (as assumed in our 2020 high price scenario) would impact power prices as much as the current undiscounted CCL if power generators pass through 50% of EU ETS price impact for the system average power mix (i.e. net cost ~€15/tCO_2). Thus, a doubled CCL would still tend to dominate power prices for consumers *outside* the heavy industries, whereas the EU ETS price impacts would tend to dominate for the energy-intensive sectors covered by CCL discounts.

Since its launch in January 2005 EU ETS prices have fluctuated, with a high close to €30/tCO_2 before returning over the summer to just below €20/tCO_2. Many analysts expect the price to fall as potential sellers become more

***Table 2** Current CCL carbon price / EU ETS equivalence*

Current climate change levy	£/tC	£/tCO_2	€/tCO_2
Carbon equivalent of CCL on electricity @ 0.43p/kWh	39	10.7	16.0
Carbon equivalent of CCL on natural gas @ 0.15 p/kWh	30	8.2	12.3
Carbon equivalent of CCL on coal @ 0.15 p/kWh	17	4.6	7.0

Notes: In discounted sectors (CCA and EU ETS) the CCL charge is one-fifth of figures here.
An EU ETS price of around €30/tCO_2 would impact power prices as much as the undiscounted CCL if power generators pass through 50% of EU ETS price impact for the system average power mix.
The EU ETS gives participating sectors a far greater incentive to save carbon by switching from coal and gas than the CCL incentive, given their 80% CCL discounts, but with lower cost burden due to free allocations.
Re-weighting the CCL according to carbon content, adjusted to give the same total tax take, would imply a carbon price of around UK £30/tC (*c.* €12/tCO_2), slightly lowering the electricity rate and almost doubling the charge on coal consumption. Modelling studies indicate a small impact on carbon emissions due to limited opportunities for substitution and the dominant impact of the EU ETS in sectors like steel and cement.
£ to € conversation at 1.5 £/€. Average grid emissions at 115tC/GWh.
Source: The Carbon Trust.

confident of their position and more conversant with the system (indeed, some countries in eastern Europe have yet to complete the registration processes). In addition, there are some indications that the impact of the EU ETS may be mitigated — and its market price consequently exaggerated — by the new-entrant and closure provisions, and the belief in some quarters that future allocations may be influenced by higher emissions at present ('updating'). All the modelling studies in this report assess the EU ETS in terms of *real equivalent price*, assuming that any such problems in the market are ironed out in the Phase 2 allocations.

The present CCA agreements in aggregate require companies to reduce emissions up to 2011 by about 1%/yr relative to 'business-as-usual' projections. We do not consider renegotiation of these targets, which is the subject of ongoing governmental assessment. However, for scenarios which include continuation of the CCAs, in the low scenarios we assume targets that do not take these sectors beyond their indicative cost-effective potential, but in the high scenarios we assume targets that require continued abatement at 1%/yr relative to projections without the CCP, up to the level of abatement that can be achieved at a cost equal to the EU ETS market price.

In all scenarios, we assume that discounted sectors receive an 80% rebate on the CCL rate for the scenario concerned. Removing the Levy entirely would remove the central incentive behind the CCAs as well as reduce government revenues, and hence this is not considered. The discount appears to be sufficient to ensure that CCL costs are small compared to underlying energy prices and fluctuations, and it is also eclipsed by the potential carbon-incentive effects of the EU ETS. Reducing the discount would increase the number of sectors potentially at competitive risk, whilst differentiation to give more (less) energy-intensive sectors higher (lower) discount rates would give rise to unmanageable complexities and would also potentially introduce perverse incentives.

Table 3 *Impacts of CCL, trading instruments and high scenarios on electricity prices*

EU ETS impact on electricity price, p/kWh

% Average cost pass-through	EU ETS price, €/tCO_2 10	15	20	25	30
20%	0.06	0.08	0.11	0.14	0.17
50%	0.14	0.21	0.28	0.35	0.42
80%	0.22	0.34	0.45	0.56	0.67

	CCL	EU ETS
High price scenario	Doubled from 2006	€15/tCO_2 real to 2010 rising linearly to €30/tCO_2 by 2020
Low price scenario	Constant real terms	€7.5/tCO_2 real to 2010 rising linearly to €15/tCO_2 by 2020
High 2010 ETS variant	Doubled from 2006	€15/tCO_2 to 2007, then €25/tCO_2 from 2008 to 2010

Scenario impacts on electricity prices, high scenario

	2010	2020
Assumed EU ETS carbon price (€/tCO_2)	15	30
EU ETS impact on electricity price* (p/kWh)	0.21	0.42
CCL at full weight (doubled from present levels) (p/kWh)	0.86	0.86
Average cost of allowances in UK CETS* (p/kWh)	0.42	0.84
Sectors in EU ETS/CCAs* (p/kWh)	0.38	0.59
Sectors paying full CCL/CCTax (p/kWh)	1.07	1.28
Sectors participating in UK CETS* (p/kWh)		
— with 80% CCL rebate	0.80	1.44
— with 100% CCL rebate	0.63	1.26

* EU ETS/CCAs sectors receive 80% discount on CCL payment. Assumes 100% auctioning for sectors in UK CETS (UK Consumption-based Emissions Trading Scheme; see Section 2.4). Assumes 50% pass-through of EU ETS carbon costs in electricity prices, system average carbon intensity of 115tC/GWh.
Source: The Carbon Trust.

2.2 Economic and target-based instruments: carbon and competitiveness assessments

Theory, evidence and estimation

The main aim of economic instruments applied to business and public sector energy use is to induce organisations to use less energy by making it more expensive. Long-standing economic theory indicates that if the target organisations are adequately informed and rational, and the markets operate as they should, this is the most efficient way to save energy and emissions: it gives organisations a broad incentive to which they can then respond in the most flexible and appropriate manner possible.

There are now two main economic instruments in the UK Climate Change Programme – the Climate Change Levy, and the EU Emissions Trading Scheme – plus the directly related Climate Change Agreements that set emission targets in return for derogations from the CCL. In addition, the UK experimented with a domestic, voluntary UK Emissions Trading Scheme in which 31 companies participated.

Economists estimate the impact of price changes in terms of *elasticities* of response. Table 4 shows the price elasticities in the two models we used. The OEF model has higher elasticities in almost all sectors, but the difference is most striking in services. The data from Cambridge Econometrics suggest that in service sectors, initial savings were due largely to the 'announcement effect' and that further price increases on their own may not have much more impact on their carbon emissions; the OEF model predicts much greater response to energy prices.

***Table 4** Responsiveness to price changes (elasticities) by sector*

	Cambridge Econometrics	Oxford Economic Forecasting
Basic metals	0.35	0.65
Mineral products	0.50	0.55 - 0.98
Chemicals	0.65	0.97
Other manufacturing	0.65	0.45 - 1.00
Services	0.12	0.50 - 0.65

Source: CE and OEF models.

As noted, all the energy-intensive sectors are protected from the full CCL through their participation in the EU ETS or the CCAs. The CCA participants are exposed to lower prices, which might reduce their abatement, but in return for agreement to meet negotiated emission targets. In practice the vast majority of CCA sectors over-delivered against their initially agreed targets.

Whilst critics take this as evidence that the targets were too lenient, closer analysis suggests at least that CCA participants have been far more likely to take action than those paying the full CCL. The evidence suggests that CCA sectors learned a lot about abatement possibilities through the process of negotiating, and their members proceeded to implement these as part of a general strategy to reduce their energy bills and ensure compliance above all to avoid paying the full CCL, frequently over-delivering in the process.

Cambridge Econometrics conclude that the evidence is visible in the econometric data (though the time period of experience on which to establish the magnitude is very short), attributing this to an 'awareness effect' of the negotiations and target-setting, and embody this in any extension of the CCA to other sectors. Cambridge Econometrics also include an 'announcement effect' associated with the Climate Change Levy – a price-independent reduction in energy use (estimated from econometric data) that started even before the CCL actually took effect. This may be similarly interpreted as a behavioural and organisational response to the higher profile of energy and the signalled expectation of rising prices.

In both models, CCAs are modelled by increasing the rate of investment in the participating sectors, based upon bottom-up estimates from the ENUSIM model. The CE model can mimic this directly; the OEF model adjusts the rate of return, which induces these sectors to undertake more investment including (but not exclusively) in energy-saving equipment.

It is too early for econometric analysis to shed any light on the actual abatement impact of the EU ETS. Its aim is to create a price incentive to abate in the energy-intensive facilities to which it applies.

Both the economic models in this study assume that companies respond to the EU ETS as a pure price incentive, abating as determined by the general elasticities appropriate to their sector, up to the market price. Since some firms may not behave in this way, the 'bottom-up' analysis in this report separates out the direct impact of allocation cut-backs from the higher delivery that would be expected if firms did abate to the market price (Section 3.1).

Finally, one potential issue identified is the overlap between various economic and regulatory instruments particularly for energy-intensive industries, with the introduction of the EU ETS. ETS participants receive the 80% discount on the CCL and the ETS allocations displace their previous CCA targets for direct fuel emissions, but the Government has maintained the electricity part of their CCA targets and of course they remain subject to pass-through impacts of the EU ETS on electricity prices. The desire to remove such overlaps without compromising carbon delivery is one motivation for exploring alternate architectures examined in this study.

Quantitative impact of the EU ETS and its impact on CCL and CCA delivery

The existing applications of the CCL and CCAs have already been subject to extensive analysis, based in part on observed market reactions. We first applied the macro-economic models to examining the likely impact of the EU ETS, and its impact on delivery of the existing instruments.

Table 5 *Carbon impact of EU ETS and CCL prices, current CCP structure, 2010 (MtC/yr)*

	EU ETS price, 2008-10 €7.5/tCO_2	€15/tCO_2	€25/tCO_2
CCL current	-4.3	-5.7	-8.5
CCL doubled	-5.9	-7.3	-9.7

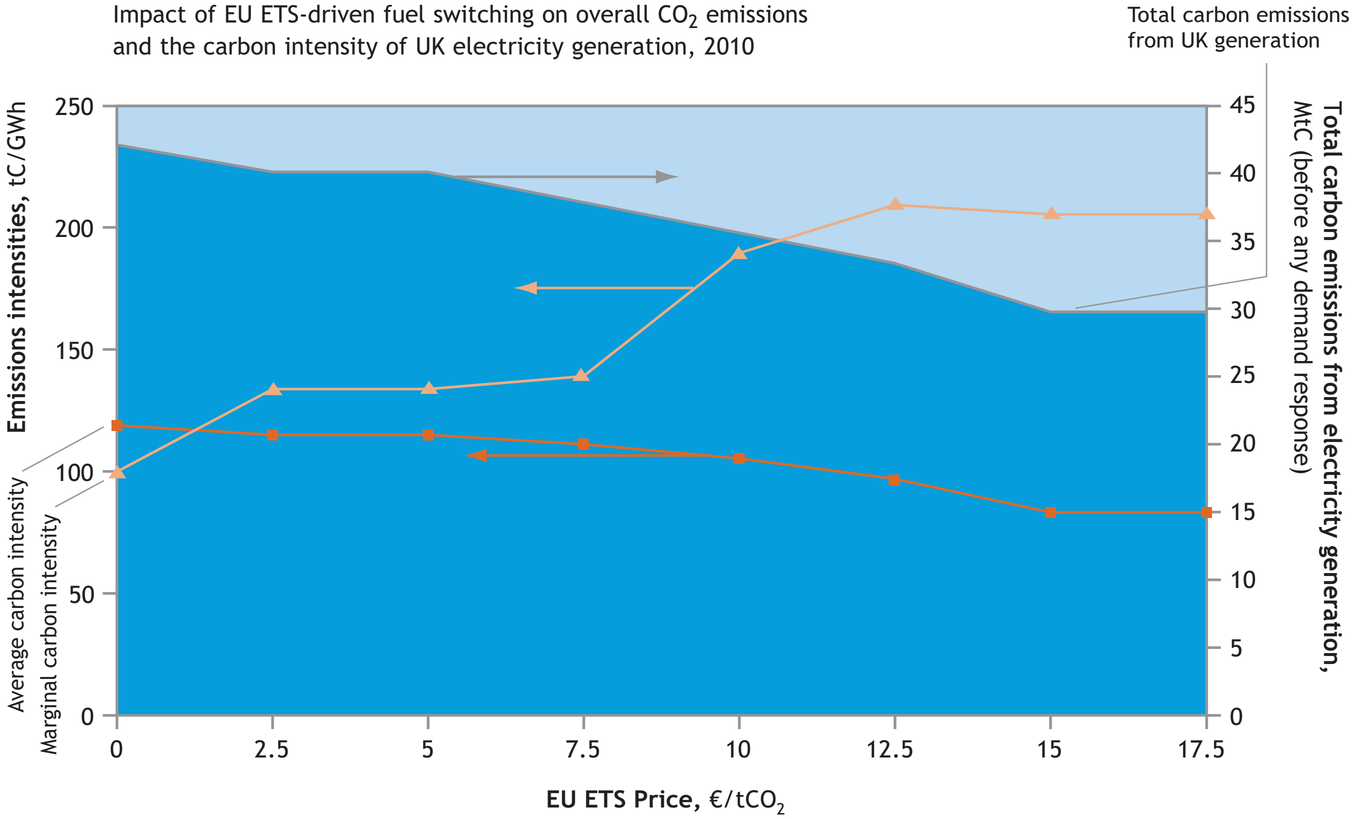
Source: Cambridge Econometrics.

The Cambridge Econometrics (CE) model includes a detailed power sector sub-model and thus can directly model the overall impact of the EU ETS on total UK emissions. The results, shown in Table 5, suggest that introducing the EU ETS may reduce UK CO_2 emissions in 2010 by between 4.3 and 8.5MtC/yr, depending upon the price. A breakdown of the components in the CE model suggests that over half of this would arise from the generators switching from coal to gas power generation. Different models, however, generate different results; the Oxera electricity model suggests much smaller impacts, because in their analysis gas plants are already used almost to capacity by 2010 even in the base case.

Chart 10 illustrates more generally, from a simpler model, how ETS-driven fuel switching might affect the carbon emissions from UK electricity, for typically projected demand and installed capacities in 2010. It also illustrates another significant feature, namely that the *marginal carbon emissions intensity* – the emissions that would be saved per unit of reduced electricity demand or increased non-fossil fuel generation – increases with ETS prices, as more coal plants are driven to operate at the margin. This model (which does not embody detailed seasonal or contractual effects), may exaggerate this feature, but this interaction between the ETS and the short-run carbon value of other measures is potentially important.

Chart 10 *Theoretical impact of EU ETS price on carbon emissions from UK (excluding Northern Ireland) electricity generation, and average and marginal emissions intensity of electricity consumption*

Impact of EU ETS-driven fuel switching on overall CO_2 emissions and the carbon intensity of UK electricity generation, 2010



The chart shows the potential impacts of the EU ETS on total, average, and marginal carbon emissions from power generation in 2010, on a pure least-cost operation basis assuming no new plant build and constant total power demand. Note how 'marginal' emissions – those that would be offset by end-use savings – almost double depending upon whether gas (low EU ETS price) or coal (high EU ETS price) is at the margin. Various constraints, both physical and contractual, may reduce the total savings from fuel switching to well below the potential 10MtC/yr saving indicated here.
Source: Cambridge SuperGen open-access model, www.econ.cam.ac.uk/research/supergen/elec-2010-calculator.xls.

As one indication of this, Table 5 also shows the impact (in the CE model) of doubling the CCL rates within the current CCP. For the low ETS price, this would save an additional 1.6MtC. As the ETS price rises, the relative *additional* impact of CCL doubling on electricity prices (and hence kWh savings) reduces, but the carbon value of that saving increases, as explained. For a medium price (€15/tCO_2) these two effects cancel and CCL doubling would again save 1.6MtC; at higher ETS prices, the former effect starts to dominate and the additional saving from doubling the CCL would be reduced to 1.2MtC.

The OEF model does not have its own power sector sub-model but does explore end-use impacts out to 2020. Primarily through its impact on electricity prices and hence demand, introducing the ETS within the current CCP structure reduces emissions in 2010 by 1MtC/yr in our low price scenario, but doubling both CCL and ETS prices reduces emissions by 3.5MtC/yr, and these savings in turn roughly double by 2020 (Table 6)[2].

Table 6 *Carbon impact of low and high price scenarios, 2010 and 2020 (MtC/yr)*

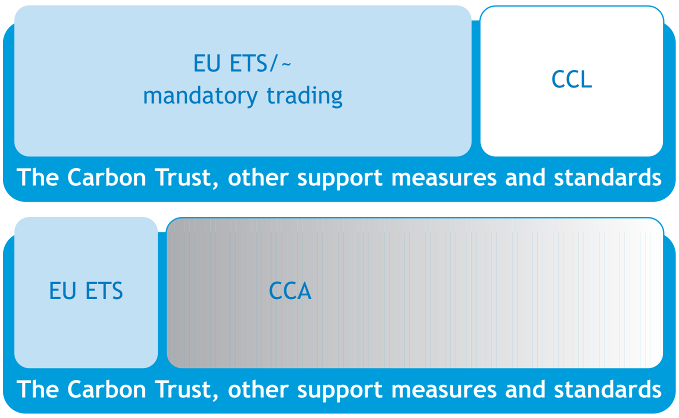
	2010	2020
CCL current, low ETS price	-1	-2
CCL double, high ETS price	-3.5	-6.2

Source: Oxford Economic Forecasting.

Removing the CCA agreements and exposing these sectors to the full price of the CCL would reduce their emissions in 2010 by 0.7MtC (over and above what would have been saved with CCA in place) according to the CE model, indicating that the negotiated targets do not give as strong delivery as the alternative full price impact. With doubled CCL and high ETS prices, removing CCAs and associated exemptions reduces 2010 emissions by 1.1MtC in the CE model. However, it is doubtful whether CCA removal is feasible anyway, given the long history of negotiating the CCA agreements specifically to reduce the financial impact of the CCL on energy-intensive sectors, and as indicated there is evidence that CCAs have delivered material carbon savings from these sectors.

Chart 11 *Coverage for extended use of direct trading and targets instruments*

Economic instrument approach; extending existing types of instrument



Direct Trading Extended

- Economic efficiency maximised assuming perfect market behaviour
- Simple instrument structure avoiding double regulation — trading/CCL only cover direct emissions

Targets Extended

- Extend CCAs setting explicit carbon abatement goals
- Relies on sector negotiated agreements, which could potentially be extended to cover SMEs

Source: The Carbon Trust.

[2] Based on OXERA analysis, these assume an average carbon emissions factor (per kWh) almost independent of price for 2010 (only 5% lower at high ETS prices), which by 2020 declines 12% (no or low ETS price) or 15% (medium-to-high ETS price) to reflect the expected evolution of the UK system and the greater likely build of low-carbon electricity sources under higher ETS prices.

***Table 7** Carbon impact of extending CCAs and EU ETS across the rest of UK business and public sectors: estimates from macro-economic models (high price scenarios)*

Package:	ETS extended			
Model	2010 Cambridge Econometrics		2010 OEF	2020
ETS price scenario	High 2010 ETS variant	High	High	High
End-use savings total	-5.9	-4.4	-2.8*	-6.3*
End-use savings non-electricity	*-3.4*	*-2.6*		
End-use savings electricity	*-2.5*	*-1.8*		
Fuel switching in power sector	-5.9	-5.0		
Total savings	-11.8	-9.4		
National CO_2, MtC**	138.1	140.5	138.5	136.8
Reported % relative to 1990**	-13.40%	-11.90%	-16.80%	-18.80%
Package:	**Targets extended**			
Model	2010 Cambridge Econometrics		2010 OEF	2020
ETS price scenario	High 2010 ETS variant	High	High	High
End-use savings total	-6.0	-4.5	-0.9*	-4.0*
End-use savings non-electricity	*-3.3*	*-2.4*		
End-use savings electricity	*-2.7*	*-2.1*		
Fuel switching in power sector	-6.1	-5.2		
Total savings	-12.1	-9.7		
National CO_2, MtC**	137.7	140.2	140.4	139.1
Reported % relative to 1990**	-13.30%	-12.10%	-15.20%	-16.80%

*The emission savings reported by OEF are derived using electricity emission factors supplied by Oxera for constant electricity demand, but these vary only slightly with EU ETS price (by 5% @ low price to 7.5% @ high price) and do not include the impact of reducing electricity demand on reducing the average carbon intensity. The savings are thus attributed to end-use, and the impact on total emissions including power generation may be somewhat underestimated.
**CE report energy-related carbon emissions only, with 1990 base of 159.4MtC, whilst OEF include non-energy CO_2 emissions, with 1990 base of 165MtC.
Source: Cambridge Econometrics and Oxford Economic Forecasting.

Carbon impacts of extending CCAs and EU ETS to other sectors

More plausible, particularly if the Government considers increasing the CCL rate, might be to extend targets or emissions trading — along with associated CCL derogations — to additional sectors. Additional reasons for considering such extensions are the 'bottom-up' evidence that the less energy-intensive sectors are not very responsive to the CCL, and 'top-down' evidence that there is less macro-economic trade-off between rising energy costs (and associated carbon reductions) and economic value-added in these sectors (see Section 3.2). Thus, extending 'targets' and 'trading' approaches across the rest of the UK business and public sectors form the first two major options for reforming the structure of the UK Climate Change Programme, which we now consider.

Rather than applying the undiscounted CCL to the energy-intensive industries, therefore, we explore the impact of extending the other two options across the rest of the UK business and public sectors:

- *Direct trading extended* removes the CCA agreements and (in modelling terms) applies the basic EU ETS principle of direct emissions trading across the whole of the UK business and public sectors (which then claim the 80% discount on the CCL) excepting SMEs
- *Targets extended* maintains the EU ETS in its core sectors, and extends the CCA agreements across the whole of the UK business and public sectors, all of which then again get the 80% CCL discount.

These options are indicated schematically in Chart 11, and the impacts estimated by the models are shown in Table 7.

The Cambridge Econometrics model suggests that introducing direct emissions trading across all of business and the public sector (except for SMEs) would save 9(12)MtC/yr for the medium (high) 2010 ETS price scenarios across the UK economy (including fuel switching). This is about 2MtC/yr more than simply an equivalent strengthening of the existing CCP structure. This impact is driven by the greater incentive on the former CCA sectors, the assumed 'awareness' effect of extending trading to new sectors, and the fact that the ETS at the high 2010 price (€25/tCO_2) has a greater financial incentive even than the full CCL, particularly on direct fuels use (Table 2). The *targets extended* package increases this delivery by about 0.3MtC/yr in each price scenario. This is because the targets (unlike the EU ETS) include electricity-related emissions, in sectors where 'awareness' effects are estimated to be important relative to price effects in the CE model.

The OEF model, in contrast, finds that both these packages save less carbon than just equivalent price increases in the existing package. This is essentially because the existing CCP relies on pure price effects outside the energy-intensive sectors: the OEF model has greater price responsiveness than the CE model, and no awareness effect associated with emissions trading. The difference is not great for the *direct trading extended* package, where greater savings from the CCA sectors perhaps help to offset lower delivery associated with removing full CCL payments from the non-energy-intensive sectors. But the difference in the target-based scenarios is striking: the greater investment associated with the OEF modelling of this instrument is good for mitigating GDP impacts (Section 3.2), but comes at a cost of offsetting most of the emission savings.

Overall though, the results suggest that neither of these approaches carries big and unambiguous advantages over the existing CCP structure, a conclusion confirmed in the comprehensive comparative bottom-up study of different packages in Section 3.1.

Sector competitiveness and overlap impacts

One of the biggest concerns about strengthened use of economic instruments in reform of the Climate Change Programme is the potential impact on the competitive position of UK business. As part of our studies, we commissioned Oxera to extend in several ways the analysis presented in an earlier study of the competitiveness implications of the EU ETS completed by the Carbon Trust.

One important addition is to consider cost impacts of overlap between the different instruments. Companies involved in cap-and-trade from direct fuel combustion also pay 20% CCL on these emissions, and on their electricity consumption they also pay any price pass-through from the impact of the EU ETS on power generation and have to deliver CCA targets. Our analysis includes all these overlaps, though the delivery of electricity-related CCA targets appears to be immaterial in cost terms because the targets do not take companies significantly beyond their cost-effective potential.

In addition, the revised Oxera analysis:

- Models the higher prices in our 'high' scenario out to 2020, with bigger allocation cut-backs by then corresponding to the targets indicated for the CCA targets (i.e. 1%/yr cutback from projected emissions without the current CCP in place)
- Includes several additional sectors
- Differentiates competition between EU and non-EU competitors
- Takes account of some specific comments received from the sectors analysed in our previous report.

Chart 12 *Net value at stake and price rises required to maintain profitability of key energy-intensive sectors under the most demanding scenarios by 2020*

High scenarios*	Net value at stake** (% of current EBITDA)		Product price rise required to maintain profits (% of current price)		
EU ETS sectors	**2010**	**2020**	**2010**	**2020**	
Cement	20%	52%	5%	**10%**	• Cement and steel potentially under threat by 2020
Steel	9%	27%	1%	**4%**	
Newsprint	1%	3%	<0.1%	0.5%	
Petroleum	0.5%	1%	0.1%	0.3%	
CCA sectors					
Car manufacture	1%	3%	<0.1%	0.1%	• Aluminium very exposed to EU ETS electricity price rises across EU
Brewing	1%	3%	<0.1%	<0.1%	
Aluminium	**80%**	**170%**	Unable to maintain current profits		

Note: *Includes impact of doubled CCL plus direct and indirect EU ETS effects; **Net value at stake = (increase in total costs after allocation)/(starting EBITDA), EU ETS prices 2010: €15/tCO_2, 2020: €30/tCO_2, allocation cut back 1% p.a. from 2005.
Source: Oxera.

Our previous analysis emphasised that a key dimension of competitiveness concerned the ability to pass costs through to customers, and found one of the most insightful indicators to be the extent to which industries would need to raise prices in order to recoup their cost increase, i.e. to maintain profits. Chart 12 shows the results for our original sectors plus petroleum, car manufacturing and brewing.

The results tend to confirm the conclusions of our previous study out to at least 2010. Aluminium smelting cannot maintain its competitiveness if it has to buy power from the grid – plants with their own generation will be largely shielded from these effects (~20% of EU smelters). The cost uplift for newsprint, petroleum, car manufacturing and brewing is extremely small and the corresponding price uplift required to maintain profitability is very small.

For steel and cement, the picture is broadly similar though more complex, with differentiation between the 2010 conditions and the more severe conditions of the high scenario in 2020. In the former conditions, the price increase required to maintain profitability – 1% and 5% for steel and cement respectively – are not large compared to other factors affecting competitiveness positions, e.g. international differentials, price fluctuations and transport costs etc. By 2020, however, the corresponding price increases required – 4% and 10% respectively – are both large enough to be a source of real potential concern. This suggests that in extending the EU ETS beyond Phase 2 (2008–12), serious consideration may have to be given to these sectors with respect to allocation and potential border protection, if key competing nations are not taking equivalent action.

This data includes the direct effects of the EU ETS on coal and gas costs and the indirect effects on electricity. They do not include the possible *indirect* effects of fuel switching on fuel markets. However, the likely increase in gas demand for power generation in our high scenarios may be largely offset by the savings in buildings heating; the net sign as well as degree of impacts may thus be uncertain in terms of overall market effects in the packages considered below. Moreover, the two key sectors of steel and cement are both large coal consumers and power sector fuel switching would *reduce* pressure on coal markets and prices. Analysis of such indirect fuel market effects, if done at all, needs to be done comprehensively. In the cases considered here, we do not believe these effects, if quantified, would alter our conclusions.

Notwithstanding these potential complications, the basic conclusions from the sector modelling studies remain encouraging, as described further in Section 3.2.

2.3 Information and standards-based instruments

"Our worst property is 13 times less energy-efficient than the best."

— Major UK retailer

"You should be pleased if you have the measurement systems in place to know that."

— Response from another retail company

Illustration of opportunities and obstacles in the UK commercial buildings sector, from Consultation Workshop hosted by the CBI in May 2005.

This section analyses instruments, applied particularly to buildings-related energy uses, which either force change through regulation and standards or incite change by making performance and options to improve more visible:

- Building regulations set standards for new build and major refurbishments, the key intervention points for adoption of fundamentally improved energy performance in buildings
- Labelling and improvement identification in the existing building stock, through asset and operational ratings under the Energy Performance of Buildings Directive (EPBD)
- Product standards, forcing the adoption of improved technologies in both new builds and the existing stock on equipment renewal.

Whilst information – and basic trading standards – are important in all sectors, they assume central relevance where the barriers to improved energy efficiency are non-financial. As noted in Section 1.2, such non-financial barriers appear to dominate in all sectors outside the energy-intensive industries, and particularly concerning buildings-related energy, upon which we focus.

Energy efficiency in non-energy-intensive sectors

The opportunity

The non-energy-intensive sectors represent over half of business and public sector emissions, and most of their emissions are building-related. In 2002 non-domestic buildings emitted 22MtC from around 1.8 million buildings, about 15% of total UK CO_2 emissions, and this figure is projected to continue to grow sharply with the continuing expansion of commercial and public services.

The potential for improvement varies enormously. In theory new buildings can be built to consume extremely low levels of energy, and create low/zero net emissions if utilising integrated on-site renewables. In addition to top-level insulation, such step change energy performance improvements can be achieved through the optimal positioning of buildings, the integration of solar shading into the exterior design, the optimal use of day lighting, the use of natural ventilation, etc.

Since the rate of new build is ~1–2% p.a. of the total stock, improving new non-domestic buildings will only deliver significant change over the long term. Thus there is also a need to improve the energy efficiency of the existing stock. The carbon reduction potential from existing buildings is obviously much less. Nevertheless, the cost-effective potential (@15% IRR) out to 2020 using existing technologies is at least ~18% or 3.8MtC p.a., and the technical potential is much higher. More efficient heating and lighting systems and building management controls offer much of the potential, along with behavioural measures such as adjusting temperature controls or switching off lighting and electrical equipment when not in use.

There are natural opportunity points in the life cycle of a building where the cost of carrying out energy efficiency measures is marginal – e.g. during a major refurbishment.

Key barriers to uptake of energy efficiency in non-domestic buildings

Market misalignment	
Metering	*"We have no incentive to reduce energy consumption because we have no visibility on what we are being billed – we just don't trust it. This kills management time – the team* (of energy managers) *spends all its time trying to get the bill right."* **Major retailer**
Landlord–tenant divide	*"We can't pass capex through in the service charge so we have no incentive to invest. Our tenants have no appetite to rent low energy buildings – it's just not part of the buying decision – rent, floor area, footfall, etc. are all more important."* **Major commercial landlord**
Behaviour and motivation	
Materiality	*"Costs are not material. Even if* (energy efficiency) *investments have a short payback tenants won't do anything as it's not on their radar screen. As a proportion of their total rent, energy is small."* **Facilities manager**
Financial disconnects	*"Energy efficiency incentives need to work at facility level. However, if the facilities do make savings they are clawed back at Area Manager level, so facilities are not that motivated."* **Public sector**

Source: Participants at consultation workshops held in March and May 2005.

The barriers

Market failures and (lack of) materiality are the key barriers to energy efficiency take-up in buildings (see illustrative quotes).

Energy costs in commercial buildings are usually a tiny proportion of the organisation's cost base – far smaller than rental and staff costs, for example[3]. This leads to an understandable lack of interest: most commercial and public sector organisations just pay their electricity and gas bills without thinking about opportunities to save energy. This lack of materiality reflects the fact that even the most cost-effective individual measures, with high rates of return, save relatively small amounts of money in absolute terms (Chart 13 shows typical magnitudes for an average-sized non-domestic building (~1000m^2)). Obviously, for larger integrated refurbishments or new build projects emission savings are much greater, also optimal solutions come in packages of measures, which are different for different buildings at different stages in their life cycle. Notably, the cost of incorporating energy improvements during a major refurbishment is lower than most one-off measures outside the refurbishment cycle.

A second, long-standing problem is the landlord–tenant divide, where the benefits of investment in energy efficiency made by the landlord are received by the tenant in the form of lower energy bills. As most commercial buildings are leased, this is a particular problem in the non-domestic sector.

Poor metering is also preventing action. All too often, bills do not reconcile with actual energy use in the commercial and public sectors. This is diverting the attention of management away from energy-saving measures, both because getting agreement/bill reconciliation takes time (and can generate significant financial gains) and because there is little point reducing electricity consumption if the reduction is not going to translate into the final bill.

The key policy challenges

From a climate change policy perspective, the CCL is a blunt instrument in this sector and all the other new instruments introduced in recent years – CCAs, EU ETS, etc – have been designed to target emissions from industry, particularly manufacturing processes, rather than buildings-related uses. Clear opportunity remains to increase the take-up of cost-effective measures in buildings.

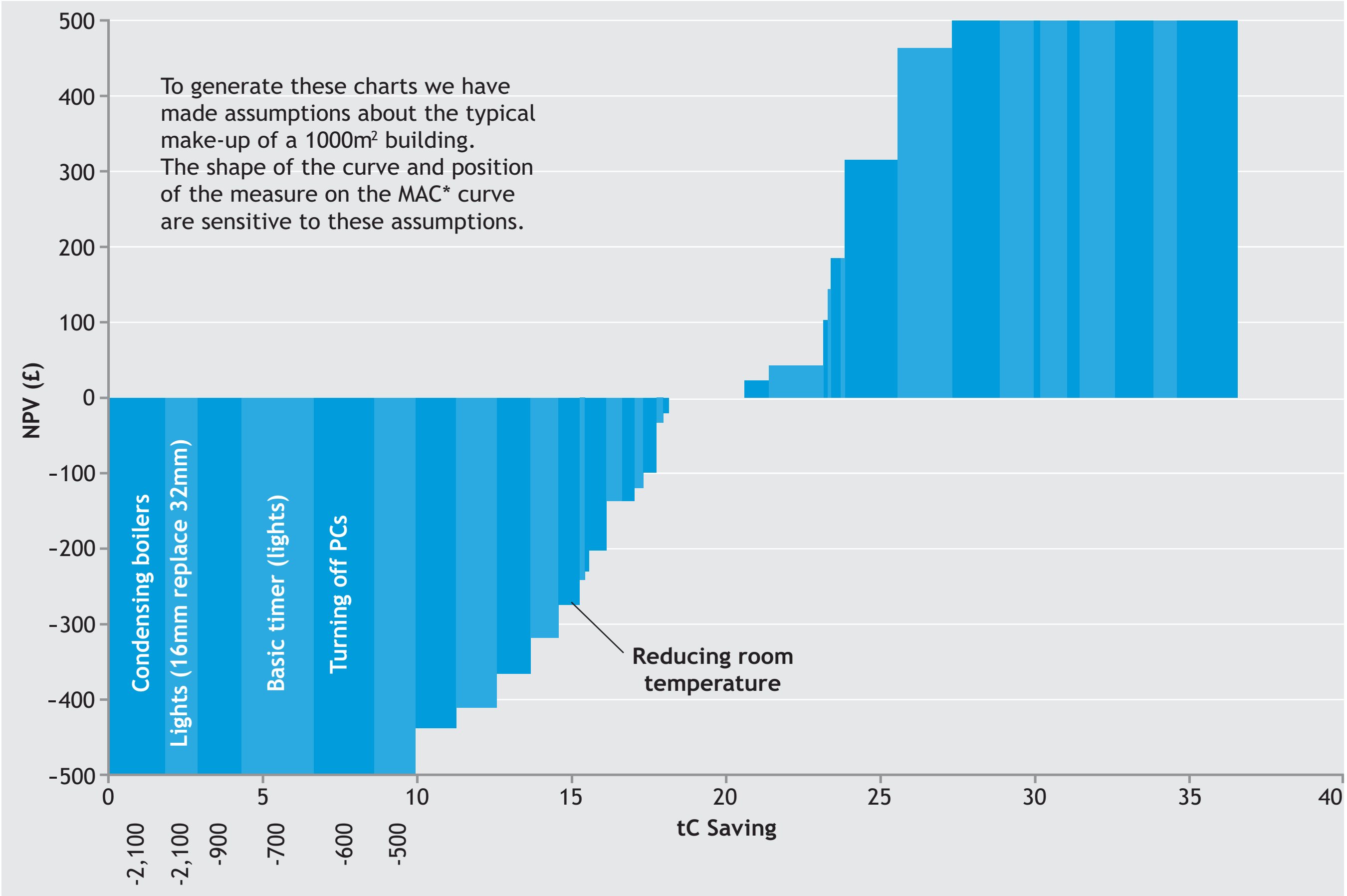
To achieve this, three distinct challenges must be addressed:

- Drive improved technical characteristics of building structures and consuming products, through action affecting the builders, manufacturers or asset owners
- Facilitate and demonstrate to users that energy and carbon savings are potentially available in ways that would not increase their costs
- Motivate users to act on these opportunities.

The rest of this section addresses the first two challenges (the next section, on 'new instruments', considers the third). In buildings, the corresponding specific levers are UK building regulations, and the EU Energy Performance of Buildings Directive (EPBD), summarised in Chart 14. Product standards and labelling perform equivalent roles with respect to other aspects of energy use in these sectors.

[3] Typical office costs in the UK (rental + service charge + business rates) range from £160/m^2 to £855/m^2 per annum. Energy typically represents between 1–6% of this total cost. Sources: www.uktradeinvest.gov.uk and BRE.

Chart 13 Net Present Value (NPV) of carbon abatement measures for an average non-domestic building (~1000m²)



Note: *Marginal Abatement Curve (MAC) plots individual abatement measures in turn in order of cost (starting with the lowest cost, or in this case those creating benefit) with each measure occupying a bar that is scaled on the x-axis in line with the measure's carbon reduction potential.
Source: Enviros analysis based on BRE abatement curve source data.

Chart 14 Building Regulations and the EU Energy Performance of Buildings Directive (EPBD)

	Core features	Rationale	Possible extension
Building Regulations – New Build	All new non-domestic buildings covered – requires energy performance standard	Brings new-build standards to a level consistent with meeting long-term CO_2 reduction targets	Continual tightening of regulations every five years
Building Regulations – Refurbishment	Sets elemental standards for refurbishment of existing buildings	Targets existing building stock which would not be covered by new-build regulations	Continual tightening of regulations every five years
EPBD Asset Ratings	Requires all buildings to obtain a certificate stating the intrinsic energy performance of the building	Targets designers and landlords and requires focus on energy performance at transaction points which are more frequent than refurbishments Allows for benchmarking	Requires improvement between successive certifications
EPBD Operational Ratings	Requires all 'public' buildings >1000m² to obtain and display a certificate stating the in-use performance of the building	Targets tenants/occupiers to reduce energy consumption and makes data transparent to all stakeholders Allows for benchmarking	Applies to all buildings >1000m², representing ~85% of floor area with ~6% of buildings

Source: The Carbon Trust

New Buildings Regulations (Part L)/(Part J in Scotland)

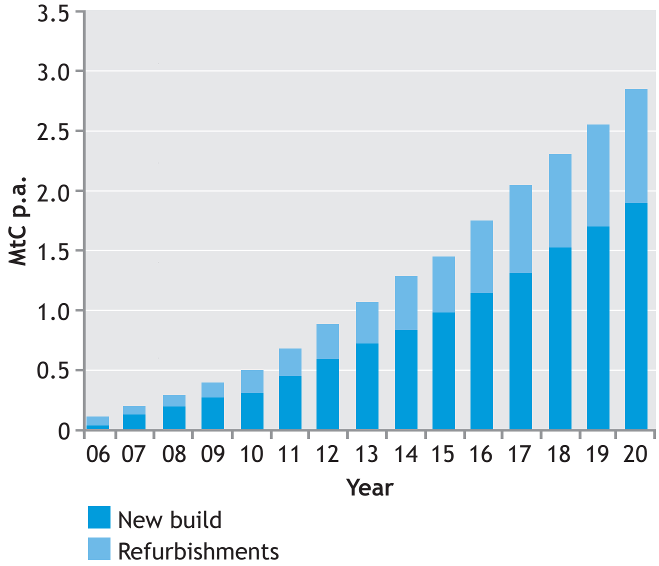
The 2005 revision to Part L of Building Regulations in England and Wales is set to tighten the standard for CO_2 emissions from new buildings by over 25%, with a similar tightening of the standard for refurbishment of existing buildings. Given that the new-build rate in the UK is around 1–2% of the stock, the effect of new-build regulations will cumulate over the very long term. Continued tightening of the standard with successive revisions to Part L every five years is required to make progress towards the 2050 target of reducing UK emissions by 60%. The consultation document issued by the Office of the Deputy Prime Minister (ODPM, the Government department responsible for this policy)[4] points to a tightening of building regulations between 20–25% every five years. Indeed, if all new buildings built between now and 2050 are to emit 60% less CO_2 than would have been the case under the 2002 regulations, the regulations need to be tightened by at least 18% every five years until 2050. As short-term cost-effective measures are used up, this could come from a combination of further demand-side reductions and building-integrated renewables. Any reduction in the carbon intensity of grid mix electricity will also help to achieve emission reductions.

The problem remains that most of the emissions from non-domestic buildings between now and 2050 will come from buildings that already exist. To capture reductions from the existing stock the building regulations are now taking a stronger stance on major refurbishment projects and this is key to moving the existing building stock towards the long-term abatement targets. A similar tightening of the regulations to that in the new build sector is more difficult in this instance, since the technical potential saving available is typically less. No explicit targets are given in the ODPM consultation for refurbishments, as improvement potentials are very situation dependent. ODPM's consultation indicates that if more than 25% of a building is to be rebuilt, new build regulations apply. However, in other major refurbishments reasonable recommended measures are expected to be taken up depending on the situation (e.g. insulation etc). We have assumed the tightened 2005 refurbishment regulations generate a 5% improvement in energy performance (in line with estimates made in ODPM consultation) and that they are tightened by 5% every five years on an ongoing basis.

Chart 15 illustrates the potential carbon savings to 2010 and 2020 resulting from the tightened regulations due to come into force in 2005, from both new build and refurbishments. The total annual saving by 2020 of ~3MtC (~2MtC from new build and ~1MtC from refurbishments) is very significant. This, if achieved, will form a big component of the expected delivery of the overall Climate Change Programme.

Two initiatives will help to support the delivery of tightened building regulations: central Government's target

Chart 15 *Potential savings from new build and refurbishment under proposed 2005 Building Regulations*



Note: Impact is due to a step change improvement in 2005 and then ongoing tightening of regulations every five years. New build and refurbishment delivery based on 1.7% build rate and 2.8% refurbishment rate respectively. 2005 regulations assumed to generate 17% and 5% improvements vs. 2002 new build and refurbishment regulations respectively (conservative performance assumption, below new build target of 25% improvement). Regulations then tightened every five years by 20% and 5% in new builds and refurbishments respectively on an ongoing basis.
Source: Ecofys.

to procure only top-quartile buildings, and a new Code for Sustainable Building (CSB) that is currently under development. The former is important as the public sector is a major user of non-domestic buildings (see Section 2.4). The CSB is a joint initiative by industry and Government looking to set a single voluntary national standard for sustainable building that industry will subscribe to and use as a point of differentiation that customers can look for as a sign of quality and lower running costs. This code is likely to go beyond the requirements of building regulations and will set criteria for wider resource efficiency, covering energy use, water resources, material resources and health and well-being. The code is under development and roll-out is planned for 2006, focusing on house building in the first instance. As a voluntary code for new builds, it is difficult to attribute additional savings to this scheme currently, but it will undoubtedly help the best performers go further and help to illustrate exactly what is achievable through energy-efficient and sustainable design.

Information and the Energy Performance of Buildings Directive

The EU Energy Performance of Buildings Directive (EPBD), which comes into force in January 2006, is a significant opportunity to influence both landlords and tenants to improve energy performance in their buildings. Among other things, it requires building owners and occupiers

[4] '*Proposals for amending Part L of the Building Regulations and Implementing the Energy Performance of Buildings Directive*', ODPM, July 2004.

to generate energy performance certificates, analogous to the way many 'white goods' are now labelled with their energy performance. The differentiation of building energy performance using grades and labels will inform and encourage landlords and tenants to take action – who wants their buildings to be amongst the worst performers?

The EPBD has two key components: asset ratings and operational ratings. The asset rating will measure the intrinsic energy performance of the building, taking into account the building fabric and systems to generate an expected energy performance of the building based on a standard usage pattern. Clearly, this will be of most concern to landlords/building owners, and asset ratings will be required to complete any transaction on a building – sale or lease. Coupled with the Government's commitment to procure only top-quartile energy performing buildings[5], this rating may open up value differentials (either in terms of rental or resale value) based on the energy performance of a building.

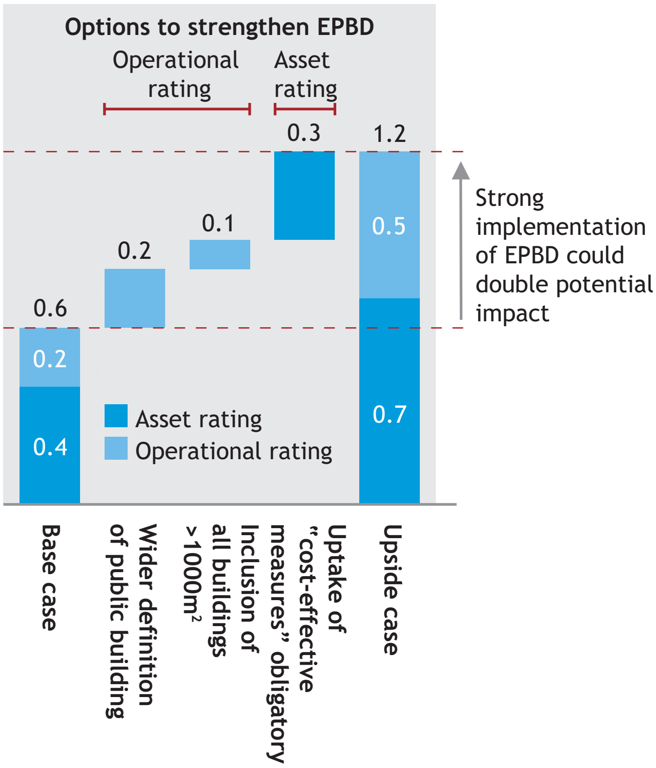
The operational rating will measure the (normalised[6]) actual energy consumption of a building. This will be of more concern to tenants, who ultimately have control over the usage of heating, lighting and power within the building. In buildings over 1000m² that are used to provide a public service and therefore frequently visited by the public, there will be a requirement to display the operational rating in a public place. This will allow the public to see the energy performance of a building in use. The aim is that responsible companies will then take measures to improve their operational rating and thereby demonstrate a responsible attitude in terms of emission reduction. Both asset and operational ratings will come with a list of recommendations on how to improve energy performance in the building concerned.

The EPBD is an important lever that could make energy efficiency part of building purchase or rental decisions by increasing transparency of building energy use. White goods labelling has been able to transform the market. The energy efficiency rating of 'A' has become synonymous with quality (as well as the benefits of energy saving and emissions reduction). The EPBD provides the opportunity to have an equivalent scheme for non-domestic buildings. The lists of carbon reduction measures that will accompany certificates have the added benefit of providing a clear path for building owners and users to improve their performance rating.

Chart 16 illustrates the potential carbon savings that could come from the existing stock, using known abatement opportunities driven by asset ratings and operational ratings. It also highlights the additional savings that could be achieved if: (1) the widest definition of public buildings is used for the display of operational ratings; (2) all buildings >1000m² are required to display operational ratings; and (3) the uptake of 'easy/cost-effective' measures in asset rating certificates were made obligatory. The total carbon prize is significant, over 1MtC p.a. reduction by 2020, on top of the 3MtC saving achievable through building regulations described above. These figures are conservative, based on low levels of take-up of the cost-effective recommendations to be provided in certificates: 10% is assumed for asset ratings and 15% for operational ratings. These estimates are based on the lower end of implementation rates observed in the energy site surveys conducted by the Carbon Trust across the commercial and public sectors. Finally, it was assumed that if the implementation of cost-effective measures was made obligatory in asset ratings, an additional take-up of 1% p.a. could be achieved on an ongoing basis (i.e. 10% take-up from making cost-effective opportunities transparent and a 1% p.a. take-up from making implementation obligatory).

To achieve the full potential offered by the EPBD illustrated in Chart 16, phased implementation of the strengthened form of this instrument should be put in place (described further in Section 3.3). In summary the operational rating in time should apply to all large non-domestic buildings and the uptake of 'easy measures' in asset ratings should be made obligatory.

***Chart 16** Potential carbon delivery from Energy Performance of Buildings Directive (EPBD)*



Note: Base case asset rating delivery based on 10% of cost-effective measures being taken up in each certificate issued. Asset ratings produced on sale or re-lease of all non-domestic buildings – assuming 10 year sale/re-lease cycle around 180,000 buildings certified each year. Making cost-effective measures obligatory in asset ratings is assumed to result in an additional take-up of measures at a rate of 1% p.a. on an ongoing basis (i.e. 10% take-up from making cost-effective opportunities transparent and an additional 1% p.a. take-up from making implementation obligatory). Operational rating delivery based on 15% implementation rate of cost-effective measures in base case with narrow definition of public building and when definition of public building is broadened to include retail, hospitality, etc. On expanding operational ratings to cover all non-domestic buildings over 1000m², lower implementation rate of 10% of cost-effective measures is assumed.
Source: Ecofys.

[5] See *'Energy Efficiency the Government's Plan for Action'*, April 2004, Paragraph 136.
[6] To take account of deviations from standard usage patterns, the operational rating will need to be normalised before it can be compared with benchmark information.

Product standards and labelling

The challenges for energy-consuming products are conceptually remarkably similar to those for buildings. The two dimensions of driving technical improvements, and informing users about options, can be addressed respectively through product standards, and labels and lists:

- ***Minimum standards*** remove poor equipment from the marketplace, and create the option to tighten standards over time. Simply removing the option of installing inefficient equipment can be particularly important in facilities management, where it is often easier to just replace like for like rather than investigate more energy-efficient alternatives
- ***Labelling or the creation of preferred accredited technology listings*** allow business consumers to differentiate products and create a market pull for better energy performance.

International experience

Both approaches can be implemented in a number of different forms. For example, Japan and the US have introduced variant forms of minimum standards that offer increased flexibility for manufacturers to improve standards over time.

Japan's Top Runner Programme sets standards according to the energy efficiency level of the most efficient product available in a given category (it covers passenger cars and trucks, air conditioners, heat pumps, fluorescent lights, refrigerators, TVs, VCRs, photocopiers, computers and hard-disk drives). Basing targets on best-in-class equipment dramatically improves the energy efficiency of products and stimulates technology development. For example, the Top Runner Programme is expected to deliver a ~60% reduction in the weighted average energy consumption of heat pumps by 2010. However, the Top Runner Programme achieves this in a flexible way by setting a lower limit for the average efficiency of each manufacturer's total output, rather than imposing minimum energy performance standards for individual appliances. This leaves more freedom to the manufacturer to adapt to the new regulation; they are free to keep higher energy-consuming equipment on the market but they have to stimulate purchases of more energy-efficient equipment or develop new more efficient products in order to meet the sales-weighted average efficiency target.

The US Corporate Average Fuel Economy (CAFE) standards for passenger cars and light trucks adopted a similar approach to allow increased flexibility for manufacturers. The CAFE standards are applied on a fleet-wide basis for each manufacturer; i.e. the fuel economy ratings for a manufacturer's entire line of passenger cars must average above the standard set for fuel consumption to comply with the standard. If a manufacturer does not meet the standard, it is liable for a civil penalty of $5.00 for each 0.1 mpg its fleet falls below the standard, multiplied by the number of vehicles it produces. Manufacturers earn 'credits' for exceeding CAFE standards, and these credits can be used to offset fuel economy shortfalls in the three previous and/or three subsequent model years.

In the EU, most applications of energy efficiency standards and labels have been in the domestic sector, and are less developed in commercial and business sector equipment partly due to the diversity of these sectors.

Applications in the UK business and public sectors

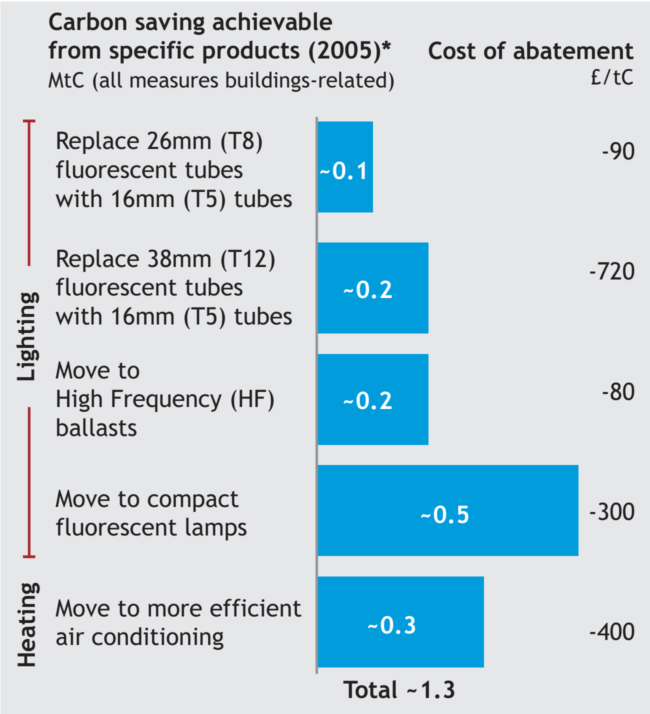
The UK Government's Enhanced Capital Allowance scheme for energy saving equipment, whilst providing a financial incentive for the consumer, in addition acts as a driving force to improve the quality of goods that manufacturers bring to market. To qualify for a capital allowance, equipment must appear on the Energy Technology List (ETL). Currently, nearly 9,000 products from 15 technology groups have qualified to appear on the ETL. The qualification criteria for the ETL have impacted the product development of many manufacturers, who value the seal of approval associated with qualification for a Government financial incentive. Raising the ETL eligibility criteria is thus one means of improving the products brought to market, without going so far as to set obligatory standards.

There are a number of products used in non-domestic buildings where standards could be applicable, particularly in the areas of heating and lighting. Chart 17 shows five illustrative technologies that product standards could be applied to, selected from the detailed BRE abatement curves in conjunction with representatives from the Government's Market Transformation Programme (MTP) who are tasked with improving the energy efficiency of products.

Chart 17 indicates that for just the illustrative products selected, minimum standards introduced from today could save ~1.3MtC p.a.. Allowing for realistic replacement cycles and expected uptake of higher efficiency equipment that would have occurred in any case, these minimum standards would be expected to save ~0.7MtC annually in 2010 if applied in isolation.

Mandatory labelling would require manufacturers to explicitly label their products with energy efficiency performance data, audited by verification agencies. This data could also be used to compile and update the Energy Technology List (ETL), explicitly linking the labelling scheme to ECAs to strengthen the business case for manufacturers to improve their energy efficiency standards. Labelling as a stand alone measure rather than standards might lower uptake of the cost-effective opportunity; we estimate such a scheme might deliver about ~0.1MtC and ~0.3MtC in 2010 and 2020 respectively across the technologies selected in Chart 17.

***Chart 17** Annual carbon savings achievable from products to which standards could be applied*



Note: *Assuming uptake of all remaining improvement potential in 2005.
Source: Market Transformation Programme, BRE buildings measures abatement curves.

In addition, there are other areas where product standards could offer significant efficiency gains. One of these is IT equipment, where product standards could focus on either the procurement of better quality equipment or on the more effective use of current stock, or both. Whilst any requirement to replace equipment inevitably carries a cost, changes in usage require minimal expenditure.

One potentially powerful, but simple tool, to change the way IT is used by businesses is to utilise existing power management capabilities that allow computers and monitors to enter low-power states when sitting idle. Nearly all machines now carry the facility but use is very low in practice, estimated at only 5%. Equipment is not always shipped with power management enabled, and even when it is, the facility is routinely disabled by the receiving IT department — who are of course not held accountable for the added costs and emissions involved.

Whilst not all PCs can be power managed (network connections must be kept open), there is no such restriction on monitors. Power management has already been successfully promoted in the US by the Energy Star Programme, whose 'Million Monitor Drive' Programme has successfully increased enablement rates to 60% amongst its target group of the Fortune 500 companies in the US — far above the 5% utilisation in the UK. This has been achieved by actively targeting energy managers and guiding them to activate the appropriate settings over the telephone. We calculate that compulsory power management for monitors could save ~0.2MtC/yr at present. As more efficient technology comes into use (LCD computer monitors replace existing less efficient CRTs), this might reduce to ~0.1MtC p.a..

Product standards as described are additional to building regulations (which target new builds and refurbishments) as they will impact equipment used across the existing non-domestic building stock in ongoing use. However, some of the product improvements considered are the same that other policy instruments, like the EPBD and the UK trading scheme described later, will be targeting. Product standards would ensure that some of these changes will occur more rapidly, but a significant proportion of the changes would be expected to be achieved in the longer term through other routes. One area where standards may well prove additional, even in the long term, is across the SME market where transaction costs could otherwise inhibit the uptake of better performing equipment and where trading schemes are unlikely to be introduced.

As described later in Section 3.3, product standards can actually only be introduced on a pan-European basis. The UK should actively engage in the development of standards for specific technologies of the kind analysed here, and should pursue the options it has to act independently. Namely, product differentiation through labelling and the qualification criteria used for financial incentives, plus encouraging more widespread use of power management in IT equipment.

Product and building standards and labelling address two of the challenges in tackling energy use in non-intensive operations, but their impact may be impeded by resistance of manufacturers, the bluntness of applying standards across differentiated products, the difficulty of continually ratcheting standards as technologies advance, and the fact that users may not respond to information when the costs are immaterial. Delivering the full potential of energy efficiency requires attention to the third challenge outlined for the non-energy-intensive sectors: motivating the users to do better. This leads us to the issue of new instruments.

2.4 New instruments

Introduction: the service sector gap

The use of energy – and particularly electricity – in services and light industry is one of the fastest growing sources of carbon emissions in the UK. These sectors are also increasingly dominated by large, national companies operating sites across the country. Their energy use is largely to do with operations in the buildings they occupy – this area of energy use has the greatest identified cost-effective opportunities for emissions abatement in percentage terms, and the most far-reaching barriers to cost-effective implementation.

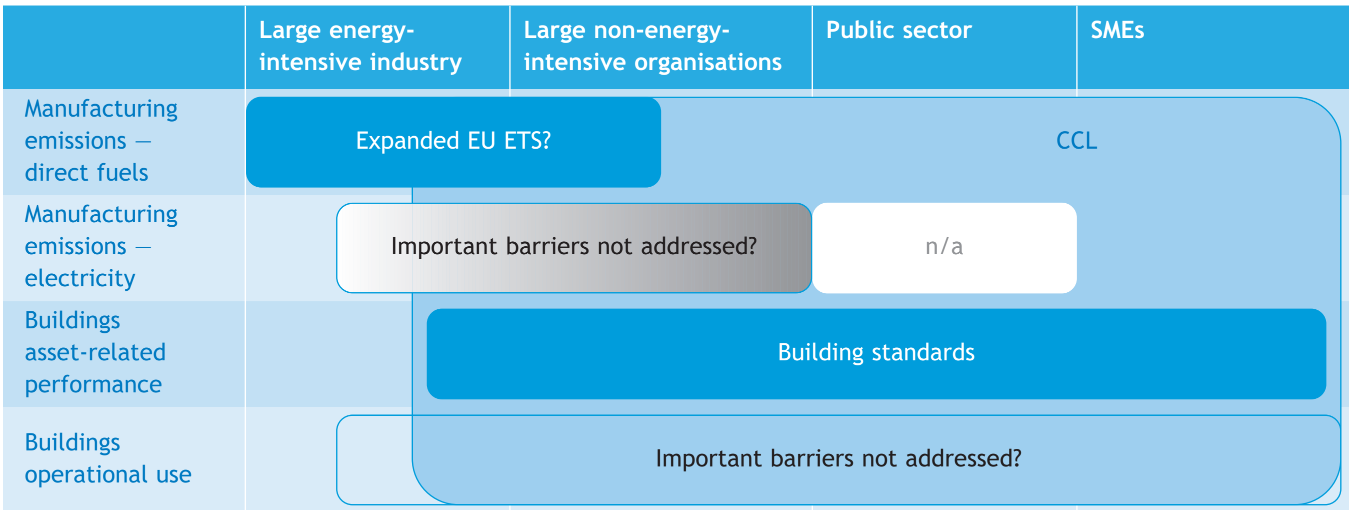
As noted previously, building and product standards could do a lot more than at present to address the technical efficiency of the buildings such companies occupy and the products they use. However, this would still not tackle the way they operate their buildings and equipment. Currently, the only policy lever operating on this is the CCL. Widespread evidence, set out earlier in this report, shows that this is a weak driver in this sector; if the commercial and public sector price elasticities are only around 0.1, even a 50% rise in energy bills would reduce energy use by only 5%. Energy costs are typically considered as an unavoidable cost of doing business. It is not a strategic issue for the companies concerned: e.g. retail companies do not lose market share because their energy bills represent a 0.1% cost disadvantage compared to their competitors.

In addition, for some of the more energy-intensive companies currently covered by the CCAs, questions remain around the continuing effectiveness of the CCAs in the future. The CCAs have been a useful and effective instrument, but it is unclear whether future rounds of target-setting negotiations should be considered after the current agreements expire, given the problems already experienced in target-setting. CCAs do nothing to help equalise control costs or to reveal a 'price of carbon'. Yet, many of the current CCA sectors may not be appropriate to move into the facility-based systems of the EU ETS, which is designed for large individual facilities and does not embody electricity at end use.

Thus, much of the service sector and light industry, and in the longer term, the less energy-intensive parts of CCA sectors, represent important gaps in the coverage of the Climate Change Programme, as illustrated schematically in Chart 18. Yet, many companies in these sectors have highly competent management structures that could be used to translate best practice in energy management across their operations nationwide. The challenge is to identify business friendly instruments that could leverage the attention of these companies to address the wastage in their energy use.

***Chart 18** Key gaps in coverage of the CCP – highlighting barriers that currently are not addressed*

For the non-economic (esp. motivation, awareness, organisation) barriers: the EU ETS cannot directly address electricity related emissions, building standards do not capture manufacturing or operational emissions and the CCL does not address key barriers.



EU ETS and CCA focused on large energy-intensive industry.
CCL is only economic instrument acting upon remaining sectors.
Source: The Carbon Trust.

UK Consumption-based Emissions Trading Scheme (UK CETS)

"If you really want our companies to address energy and carbon, you have to get emissions into the financial reporting systems through which the company management structures work."

— Participant at CBI-hosted consultation with large non-energy-intensive sectors

After reviewing various options, we conclude that the best instrument to leverage the opportunities in these large less energy-intensive sectors would be a company/organisation-level, auction-based emissions trading system, that would address energy uses outside the scope of EU ETS and CCA agreements and recycle most of the auction revenues back to the participating sectors through CCL discounts or other means. Like the original UK ETS — and unlike the EU ETS — it would include the 'embodied' emissions associated with electricity consumption (that represent around 70% of the sector's emissions) but would otherwise be quite distinct, and simpler.

The defining features would be:

- A company/organisation-level trading scheme, in which companies and public sector organisations must acquire allowances to cover their total emissions from sites across the country. They may then freely trade them with all other companies/organisations in the scheme
- Both direct and electricity-related emissions would be included (electricity could be accounted at grid average carbon intensity, or supplier-specific intensities)
- Transaction costs would be minimised by:
  - Focusing the scheme on large companies and public sector organisations (e.g. based on either energy consumption, turnover or employment threshold)
  - Basing the emissions on good metered energy bill data (possible selection criteria could include whether sites have 1/2hr electricity metering, only generally provided to sites with energy consumption above a specific threshold — see Section 3.3)
- Results to be published in company and public sector annual reports in a consistent fashion: year on year total emissions, sales and purchases of allowances, etc.
- Possible to introduce a 'safety valve' link with the EU ETS, allowing companies to buy EU ETS allowances and use them towards compliance in the event that UK CETS allowance prices rise above a specified level.

We emphasise that the emissions covered by such a scheme would not be covered by the EU ETS itself: there are no plans to extend the EU ETS to indirect emissions (electricity use) or to installations below the 20MW threshold, and emissions from any large installations registered under the EU ETS would be exempt from the UK CETS.

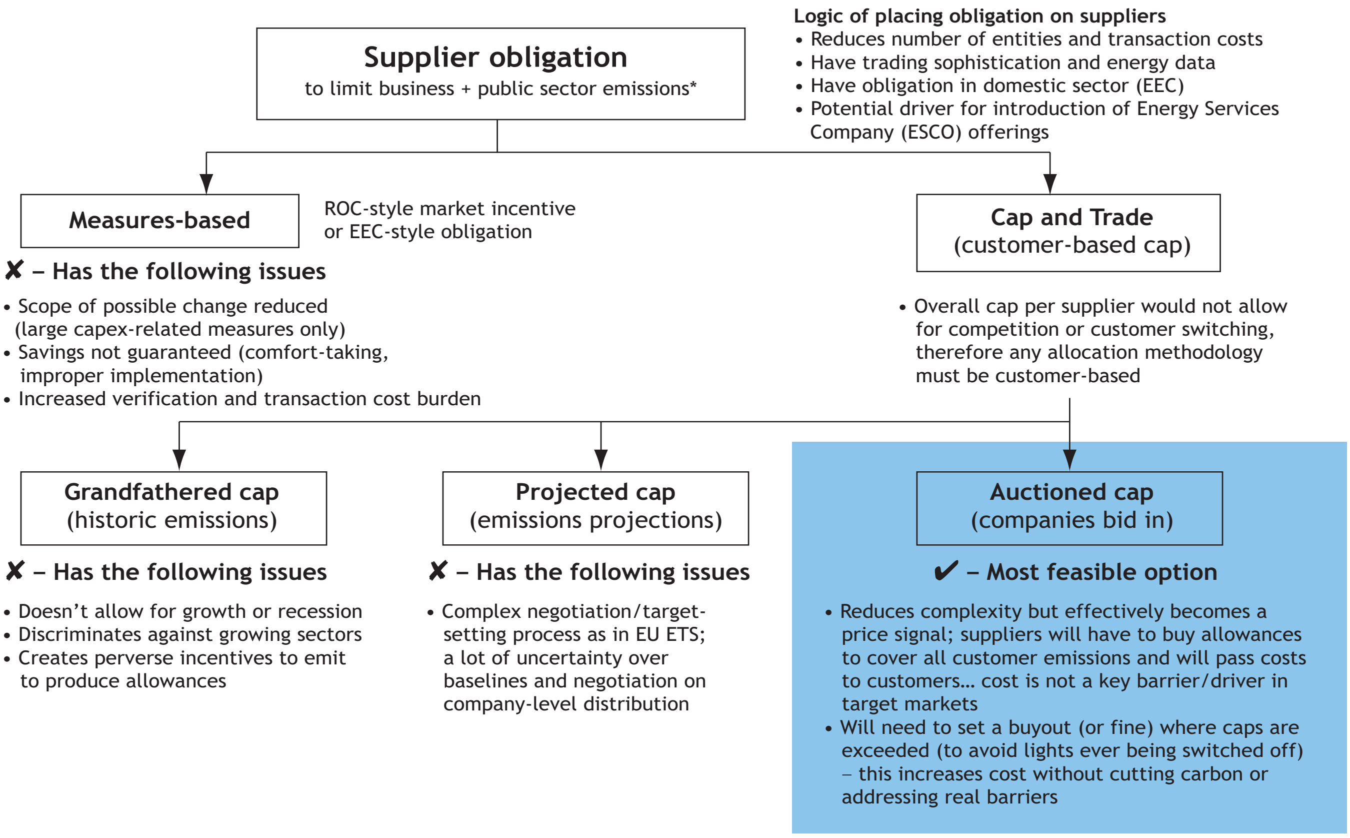
We believe the simplest implementation would auction all the allowances to avoid the complexities and administrative costs of company-specific negotiation. This could be in return for a CCL rebate to avoid creating an additional financial burden for business. The relative cost implications are set out in Table 3; in aggregate the sectors covered under the scheme would pay a little less in 2010 than under the full CCL (assuming an 80% rebate is given on the CCL on entering the trading scheme), and a little more in 2020, if the CETS carbon prices were linked to the rising EU ETS prices in our high scenario. By implication, associated Government revenues from CCL and auctioning combined would move in the opposite direction, but again with net financial differences being minor.

If the full auctioning/CCL rebate option were foreclosed, alternatives could include negotiated allocations, accepting the additional financial impact, or 'rule-of-thumb' allocations based e.g. on office floor area, although the latter would inevitably raise additional complications of definition and verification.

We estimate that such a scheme would cover baseline emissions of ~20MtC p.a. (Section 3.3). It could save ~2.5MtC p.a. by 2010 and ~5MtC p.a. by 2020 (before allowing for overlaps with other instruments, see Section 3.1). Moreover, the abatement measures taken to achieve these savings generate a significant aggregate benefit (Section 3.2). If the experience over early years of UK CETS were positive, it would also open the option to extend the UK CETS to cover some of the CCA sectors after the current agreements expire, further expanding the possible carbon and energy savings.

Although the core proposal focuses upon direct and electricity-related emissions, other sources (e.g. haulage) could potentially be included to provide a more holistic, joined-up incentive for companies.

***Chart 19** Options for implementing a 'supplier cap'*



Note: *Target market non-energy-intensive sectors.
Source: The Carbon Trust.

Other approaches to large non-energy-intensive organisations

Alternative or additional approaches to tackling service sector emissions growth could be to extend CCAs, discussed earlier; shifting the onus on to energy suppliers to limit their customers' energy consumption; or various 'credit' systems for energy-saving actions.

The idea of placing a cap on allowable sales from energy suppliers has attracted considerable popular attention, but the exact nature of the proposal is often unclear. Chart 19 maps the specific options and we conclude that an 'auctioned cap' is probably the only viable option. Chart 20 summarises the relative pros and cons of this compared to implementing cap-and-trade systems for end-users in the business and public sectors, which led us to focus mainly upon the latter. The end-user scheme is preferred because it leads companies to look strategically at their energy use and empowers the incumbent energy managers to drive change. Placing the cap on the supplier, to whom allowed sale volumes are auctioned, does not engage the user and it could end up with suppliers simply passing the costs through to customers – resulting in a far more complex version of the CCL that still fails to address the core behaviour and structural issues around the energy use of large consumer companies.

The other generic approach is to adopt a 'baseline and credit' system that seeks to incentivise specific actions, rather than addressing emissions in their entirety. Rather than capping and recording overall emissions, these would give participants credits (or '*white certificates*') for achieving savings relative to baselines, or for implementing specific energy efficiency equipment or projects.

Amongst large organisations, this would give companies credits for specific verified carbon abatement projects, which could then be purchased by a set-aside Government fund, or sold into trading systems through approved linkage mechanisms.

This would target asset-related abatement opportunities, associated with the purchase of more efficient equipment rather than behavioural measures which are harder to monitor and verify. There is a total of ~2.1MtC p.a. cost-effective asset-based abatement opportunity in the buildings abatement curve by 2020. Large non-energy-intensive organisations and public sector buildings, the key target markets for such project certificates, make up around two-thirds of this opportunity (~1.4MtC p.a.). If by 2020 ~50% of the cost-effective asset-related measures are taken up (not 100% due to its voluntary nature and implementation complexities), this would deliver ~0.6MtC p.a. If the Government were to purchase these carbon savings at

***Chart 20** Relative pros and cons of end-user cap-and-trade (e.g. UK CETS) compared to supplier cap*

Criteria	Strengths of supplier cap	Strengths of end-user cap
Relative expertise in recognising and implementing relevant 'on-the-ground' energy efficiency projects	Not a strength – low supplier familiarity with client energy efficiency processes and business situation, would incur costs of 'getting up to speed', which could be passed to the customer. Suppliers could strike deals with clients, though it would then be more direct to apply the obligation to the end-user	**Large organisations have dedicated energy managers – best placed to recognise/implement the right energy efficiency projects for their business**
Relative action on genuine business barriers and drivers	Not a strength – would act to increase prices for end-users where cost is not a significant barrier/driver for target market	**Compliance would enable internal energy managers to secure funding for energy efficiency projects on favourable terms** **Enables companies to report carbon for CSR reasons**
Minimising regulatory overlap	Not a strength – double regulation of the same company on the same issue (generators and suppliers are vertically integrated) may not be desirable	**Double regulation of the same electron rather than regulating the same company twice on the same issue**
Relative expertise in trading	**Places obligation on organisations with strongest experience of energy demand prediction and carbon trading** **May be best placed to manage SME demand-side reduction where no in-house expertise exists**	Not a strength – Trading expertise exists among some of the larger businesses – Half-hourly metering data exist for target market, so minimal extra data capture cost would be incurred
Relative administrative burden	**Reduces Government administration costs by placing burden on small no. of suppliers (<10) versus large no. of consumers (>10k)** **Suppliers would incur admin. costs and pass these through as customer price increases**	**Projects are NPV +ve therefore financial benefits can offset internal admin. costs, although Government admin. costs would be higher in this scenario** **Use metered data and current financial reporting to keep it simple**
Development of third-party Energy Service Companies (ESCOs)	**This would encourage suppliers to develop ESCO abilities but could put up barriers to entry for third parties. If regulation/business case allows, third-party ESCOs could compete more directly with suppliers**	**If regulation allows and a business case exists (customer demand + de-risked margin), third-party ESCOs would develop and the market could become more competitive/diverse**

Source: The Carbon Trust.

today's EU ETS price (e.g. ~€30/tCO_2; £70/tC), the total cost to Government would be ~£40m p.a. in 2020.

In addition to the limitations to asset-based opportunities (when a significant share of abatement opportunities are associated with behavioural change) and the voluntary nature of the approach, it may be hard to disentangle truly additional projects from those that would have happened anyway regardless of the scheme. And, partly as a result, the cost-effectiveness is questionable: the Government would effectively be paying for carbon savings that are already cost-effective, and obviously the larger projects are likely to generate larger energy bill savings, despite being more expensive for the fund to support. Also the verification of such white certificates would need complex, costly upfront and ongoing monitoring of individual projects and devices. Pre-selecting a rigid pool of acceptable measures may make verification simpler, but would significantly reduce the potential carbon savings that such a scheme could generate. On this basis, other routes to addressing the large non-energy-intensive sectors seem more preferable, for example the UK CETS outlined earlier in this report, though project-based white certificates could play a role in relation to emissions that could not be captured under other approaches (e.g. some non-CO_2 greenhouse gas sources).

Measures for small and medium-sized enterprises (SMEs)

The pros and cons of options for addressing SME emissions are less clear cut. One option would be a *Supplier EEC (Energy Efficiency Commitment)* — an extension of the existing scheme in the domestic sector where electricity suppliers are obliged to implement certified energy efficiency measures in the targeted markets.

The EEC approach in the SME market would act as another means of overcoming the key transaction cost barrier for these organisations by placing the burden for change on the energy suppliers. Larger organisations, which will usually have energy managers and more visibility of opportunities for improvement, are better placed to act on their own behalf and hence the project certificate scheme aims to incentivise them directly. Both schemes could also allow third-party market entrants to identify and implement projects on behalf of companies, supported by the project certificate value or the value of EEC to suppliers.

The cost-effective asset-based opportunity targeted by the EEC for SMEs scheme is significantly lower than that of the project certificate scheme considered for large organisations, at ~0.7MtC. Change is very hard to achieve in this market due to the cost of dealing with so many highly diverse organisations; there are over 900,000 SMEs ranging from small companies operating from home to sizeable businesses with multi-million pound turnovers. Placing an obligation on the supplier, rather than setting up a direct scheme to embrace this large number of entities, reduces the administrative burden for both Government and the SME. However, suppliers do not always hold deep relationships with their small business customers, and business customers with low energy bills often receive a comparable service to domestic customers. Allowing for this and for the diversity and sheer number of SMEs, it would seem reasonable that the EEC for SME obligation for suppliers could only be ramped up to 25% of the full available cost-effective opportunity by 2020, or ~0.2MtC p.a. This delivery is lower than most of the other instruments under consideration, however it is focused on a particularly difficult part of the market to address.

Interest-free loan scheme for SMEs

One key barrier to the uptake of energy efficiency investments in the SME market is a lack of access to affordable capital. A scheme offering interest-free loans to fund capital energy-saving projects in this market could help to overcome this barrier, particularly if linked to information provision and advice on project development, specification and recommended supplier listings. SMEs have little time to focus on energy-saving investments given the need to focus on day-to-day business, and there is a need to overcome the high transaction cost barrier described earlier.

A loans scheme would provide the means to leverage public funding effectively. Firstly, loans can be employed to part-fund a project, meaning that public funds are matched with private. In addition, capital funds committed to an interest-free loan scheme are available for use over successive years, as the loans are repaid. As a result, amounts committed today can have a lasting effect over successive years. This also means that the true cost of the scheme relates only to administration and the opportunity cost of capital.

In the longer term, there could be potential to secure private financing for such a scheme, so that public funds could be used exclusively for overhead and borrowing costs, thereby supporting a much larger available fund to support energy efficiency.

The Carbon Trust is already piloting an interest-free loan scheme for SMEs, under which loans of up to £100,000 are provided to replace or upgrade equipment. Technical support is provided to applicants requiring help with the identification or specification of energy-saving projects.

The loans are repaid out of the energy savings arising, typically over a period of ~4 years. £8.1m of loan offers have been made in the two financial years of full operation since the scheme's inception, generating a saving of 30ktCO_2 p.a.. The impact assessment data on the pilot scheme indicates that the loan fund is highly cost-effective, 1 tCO_2 is saved for every £10 spent by the Carbon Trust (on interest foregone and scheme administration) on a lifetime savings basis. Including also the investment and energy savings made by firms, the pilot has created a net benefit, of ~£7/tCO_2. Additionally, because the scheme supports the installation of energy-saving capital equipment, it offers reliability of implementation and excellent persistence of energy and emissions reductions over time.

As part of the pilot, a project has been run in which equipment suppliers were trained to promote the loan scheme as part of their sales process. This initiative has proved highly successful, not only in effectively leveraging effort and overhead costs, but in generating an increased volume and quality of applications. The concept of using the suppliers to pre-qualify their equipment in terms of energy savings removes the technical burden from SME applicants of having to calculate the carbon-saving potential of their projects. Follow-up surveys with SME pilot participants indicate that the majority of projects would have progressed more slowly, or not at all, without the support of an interest-free loan. In addition, many projects were encouraged to modify their specification to increase the resulting energy savings in order to qualify for a loan.

The success of the pilot indicates that there is potential for the programme to support a very significant expansion. Based on current models, if the Carbon Trust were to pursue its current business plan out to 2008/9, and if steady levels of additional investment were put into the scheme at a level of ~£10m of capital p.a. thereafter, by 2020/21 the scheme could have supported capital energy-saving projects of ~£800m in value (in today's prices) including the private sector investment made, and have an ongoing portfolio value of ~£150m. This would give rise to a projected annual carbon saving of ~0.2MtC p.a., again from the difficult to address SME market.

In summary, both interest-free loans and a supplier Energy Efficiency Commitment (EEC) have roles to play in delivering change from the SME market. As described in Section 3.3, both will need to be implemented in a manner that minimises the transaction costs for SMEs – it may also be appropriate to focus the EEC, at least in the first instance, on smaller companies with attributes closer to the domestic customers covered by the current scheme.

Public sector instruments

Public sector carbon emissions reduction in context

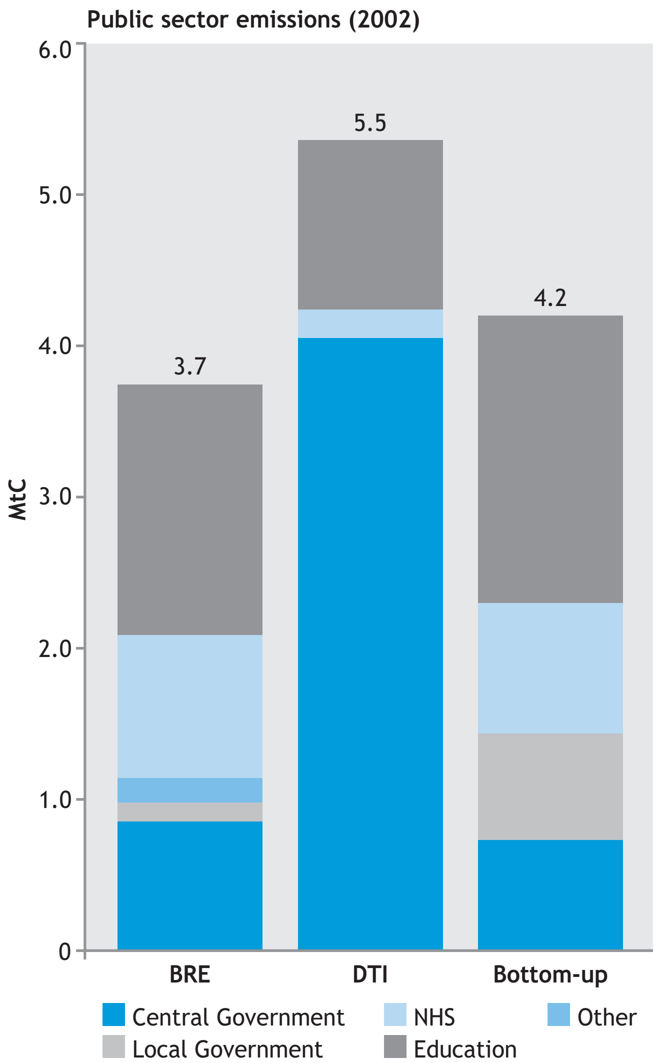
The vast majority of public sector emissions are buildings related. In 2004, the sector accounted for 34% of new non-domestic building construction and 37% of non-domestic refurbishment and maintenance work (totalling 1.45% of UK GDP)[7].

The public sector is thus in a position to lead carbon emissions reduction, not only by setting a behavioural and strategic example to the private sector, but by its very significant purchasing power. By driving the highest standards of energy efficiency and carbon emissions reduction, the sector's impact on the construction industry will have very strong knock-on effects to the private sector. From developers to architects, engineers, construction companies and facilities managers, the skills and mentality to deliver and operate low-carbon buildings could develop quickly across both public and private sectors if the public sector takes the lead.

Public sector targets

The Sustainable Development Framework for the Government Estate (2004) has a target of reducing carbon emissions across the public sector by 12.5% from 2000 to 2010 and improving energy efficiency by 15%. Instruments acting across both the business and public sectors should help to deliver this target, particularly building regulations, EPBD, CCL, the Carbon Trust, and if it were to be introduced, the proposed UK CETS. However, there is a need for the public sector to put in place better governance and support mechanisms to ensure they achieve their targets and establish a position of leadership. With the total floor area of public sector buildings growing at nearly 2% per year (mostly in health and education), there is a risk that the targets may not be met because implementation of the necessary changes is currently too slow.

***Chart 21** Emissions from public sector: different definitions and estimates*



•Baseline data is erratic with three to four differing data sets, with total emissions ranging from 3.7MtC to 5.5MtC
•Some confusion seems to be around the treatment of Local Authorities and incorporation of Local Education Authorities
•This implies uncertainty around the baseline and hence the targets.
Note: DTI figures from DUKES form basis of Ecofys analysis.
Source: Carbon Trust analysis, based on BRE, DTI, Ecofys and direct Government sources.

[7] *BSRIA Statistics Bulletin*, June 2005.

Improved governance

Better governance is required to know whether the targets are being met. At present, performance data are unclear (Chart 21), and it is not clear who has direct accountability within individual departments for either the tracking or policing of performance:

- Uncertainty over the baseline makes it difficult to translate the 12.5% reduction to a clear deliverable number
- There is little transparency, no clear accountability by department, incomplete measurement and no sanction for failure to meet targets.

New approaches to target-setting and compliance are thus required that differentiate between target groups:

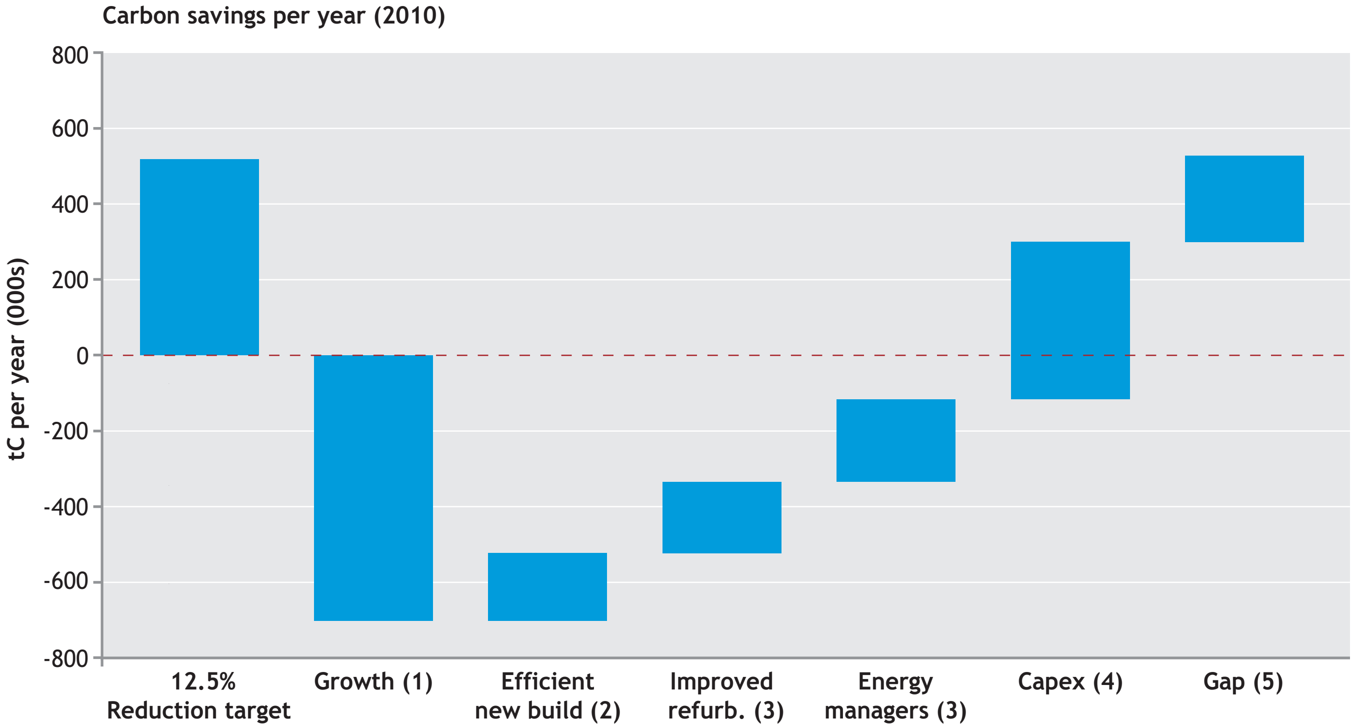
- Local Authorities (LAs) (~17% of public sector emissions) are subject to the Comprehensive Performance Assessment (CPA) whereby their objective performance is measured annually on a number of issues and compared to other LAs. The prime driver to improve is competition between LAs. Making energy efficiency or emissions part of the CPA would force transparent measurement and reporting
- For Central Government (~18% of emissions), Health (~20% of emissions) and Education (~45% of emissions), emissions should be made visible through reporting
- Individuals must be made responsible for delivering carbon reduction for their area within each department
- For the greatest impact on the construction industry, a single minimum standard of energy efficiency should be implemented across the public sector for both new build and rental as outlined in the Government's Energy Efficiency Action Plan.

Support mechanisms

In addition to improved governance and standards, support measures could help to improve performance over and above existing instruments:

- ***Appointing energy managers for entities with energy expenditure exceeding £2m*** should reduce energy consumption by 5% (maximum cost of approximately £200m per year saving ~£280m and 210ktC p.a., although a certain proportion of organisations already have energy managers).

Chart 22 *Delivery of public sector instruments*



Notes: Assuming a baseline of 4.2MtC, 12.5% reduction is 525ktC.

1 Based on 2003 construction, 4.3 million m² of new public sector buildings are built per year, creating 116ktC or an additional 700ktC p.a. by 2010. No intensity increase has been factored in.

2 PFI/Top Quartile Procurement should improve new build energy efficiency by 25% and refurbished buildings by 15%. This is incorporating the new buildings regulations. This should save 60ktC p.a. of growth or a cumulative 360ktC p.a. by 2010.

3 Energy managers will cost £70k each, costing a total of c. £200m p.a., but saving up to £280m p.a. Many are already in place. 210ktC saved p.a. by 2010.

4 Capex of £446m through a SALIX-type scheme should deliver another 420ktC. Rolling fund of three years means actual investment should be £223m, eventually saving £134m p.a.

5 Approximately 230ktC will need to be met from other measures, such as a Code for Sustainable Buildings and Carbon Trust support.

Source: The Carbon Trust.

- ***Establishing a revolving, interest-free loan fund*** that could be used to pay for capital expenditures. The loans could be repaid with savings from reduced energy bills within say three years, and lent out on a revolving basis. There is currently such a system open to Local Authorities called SALIX. SALIX Finance Ltd has been set up to assess, administer and monitor loans to Local Authorities (LAs) for energy efficiency related capital expenditures which fall outside of their normal capex budgeting process. The LA identifies the required expenditure and applies to SALIX for a loan of up to 50% of the value. In its first financial year (2004-2005) SALIX committed £687k of loans for 149 projects, saving £206k per year (equivalent to a pay-back rate of 3.3 years) and 2,300tCO_2 p.a. An equivalent scheme made available across the public sector could empower the energy managers to save 10% (£447m total funds to save 420ktC p.a. and £134m of energy per year, based on existing SALIX performance[8]). This would take the form of a 'working capital float' of £220m recycled every three years and which could eventually be recovered

- ***Improved procurement guidelines*** with rules to meet the new 2005 Building Regulations, particularly in PFI and top quartile procurement rules (as outlined in the Government's Energy Efficiency Action Plan), could save 15% on refurbishments and 25% on new builds. Further savings could be achieved by setting standards of 'Top Quartile Procurement' higher than 2005 Building Regulations. In particular, a strict 'Code for Sustainable Buildings' applied across the public sector, might alleviate the increased emissions from growth, and set a clear standard of leadership. Based on 2003 construction rates[9], 2005 Regulations would save 31ktC on refurbishments and 29ktC on new builds annually. By 2010, ~360ktC p.a. will have been saved across six years of new builds and refurbishments.

With these actions, as illustrated in Chart 22, we estimate this would still leave a gap of approximately 230ktC per year to the Government's target[10]. Support from the Carbon Trust in terms of Carbon Management and the Code for Sustainable Buildings could help to close this gap.

[8] £223m would allow two iterations of the fund over six years. Source: Salix Finance Ltd, Biannual Report No.2, 2005. Capex life cycle cost per tC is £89 (over 12 years or £1,063 up front). A 10% reduction of 4.2MtC is 420ktC costing £447million.
[9] Source: *Estimating the Delivery of Building Regs. and EPBD*, Ecofys and BRE, May 2005.
[10] The gap may be larger or smaller, depending on the actual growth rate and if energy inefficient stock is demolished at a higher rate.

3 Integration, implementation and implications

3.1 Comparative analysis of carbon delivery

Introduction

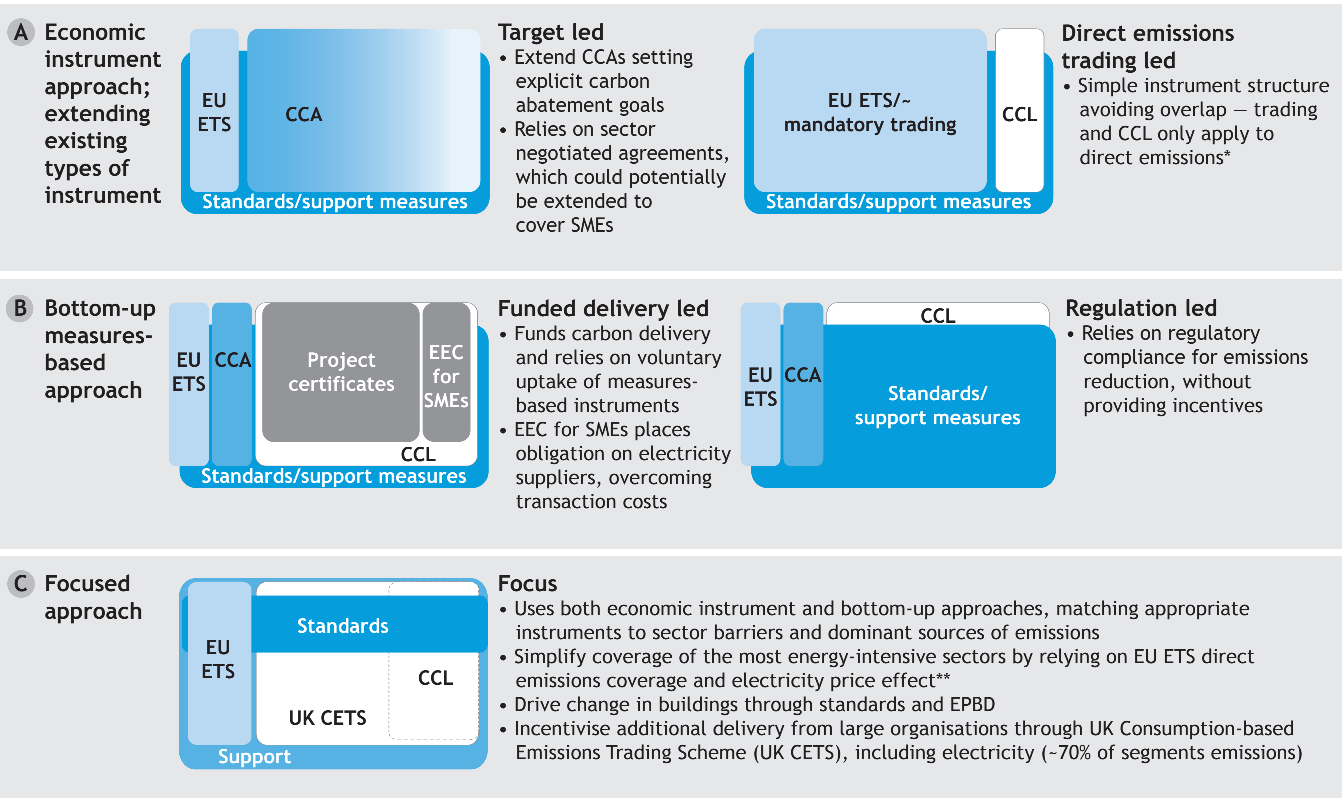
In Part 2 we explained in detail each of the individual potential policy instruments that could be used to drive change in the business and public sectors. This part of the report brings together the analysis to consider what whole packages of measures could deliver, and issues of relative cost-effectiveness. Having laid out the potential impact of the different packages we then look into issues associated with their implementation.

In addition to the current structure laid out in Chart 8, we bring together the analyses in terms of five new potential packages, each of which covers the span of business and public sector emissions but reflects philosophically different approaches to policy. Nevertheless, all of the packages use a mixture of economic instruments (price signals such as taxes and trading) and 'bottom-up' policy instruments (measures-based instruments such as building regulations and the Carbon Trust).

Using our emissions mapping structure (Chart 3), the five packages are illustrated schematically and briefly described in Chart 23. All use the price scenarios described in Part 2 and implement bottom-up instruments in the ways indicated in Part 2.

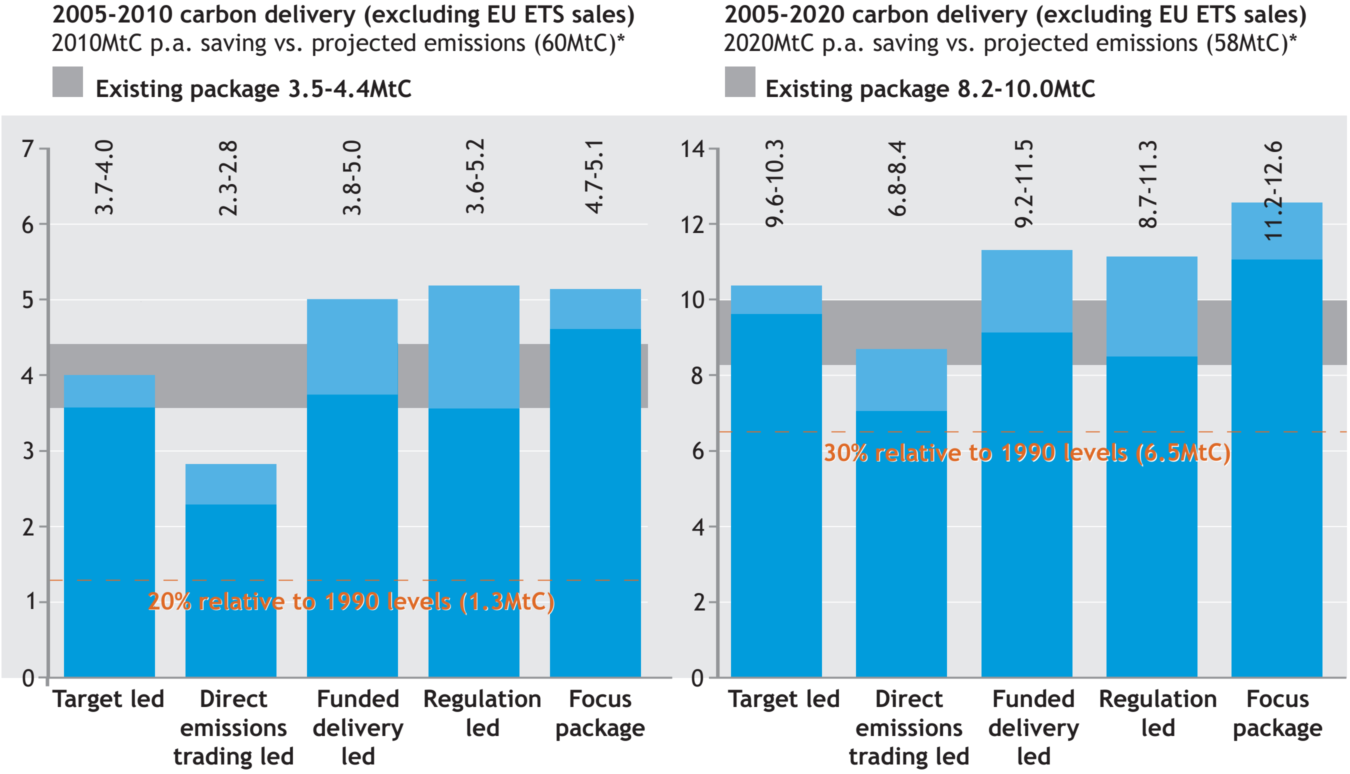
- The first two packages, the target led and direct emissions trading led, correspond closely to the use of economic instruments set out in Section 2.2, respectively led by CCA-type targets and by extending direct emissions trading, but with basic existing bottom-up support added

***Chart 23** Schematic illustration of new potential policy packages*



Note: *Rely on EU ETS price effect for electricity emissions; **Probably need to maintain CCA in short term until delivery of EU ETS is proven.
Source: The Carbon Trust.

Chart 24 *Carbon delivery by package, 2010 and 2020*



Notes: *Allowing for CCP delivery to 2005 (3MtC). The ranges show delivery associated with low and high price scenarios arising from end-use efficiency responses.
Source: Ecofys.

- The next two, funded delivery led and regulation led, take the existing CCP structure as backdrop and focus on bottom-up delivery, the former focusing upon the 'funded delivery' routes including supplier targets for SMEs (i.e. supplier-based funding of downstream measures), project certificate schemes for larger organisations and greater use of Carbon Trust-type measures, and the latter focusing upon regulatory routes including the scenarios of strengthened building and product standards set out in Section 2.3
- The final package, termed focus, seeks to 'mix and match' instruments combining the best of the other four approaches, using the existing coverage of EU ETS and CCA instruments, and adding the UK CETS instrument set out in Section 2.4 and the strengthened bottom-up components.

Macro-economic modelling can evaluate economic instruments, but cannot analyse bottom-up instruments. Consequently, for consistency of analysis across packages we use the *Ecofys bottom-up analysis to assess carbon delivery and cost-effectiveness* of the different packages, with inputs (such as price elasticities) derived from the macro-economic models. The *OEF and Cambridge Econometrics macro-economic models are used to look at potential GDP impacts.*

Overall carbon delivery by package

Chart 24 shows the delivery of each of the five alternative policy packages, compared to business-as-usual without the CCP in place, with the delivery also illustrated compared to that predicted for the existing CCP structure (grey horizontal bar).

All packages except the direct emissions trading led package where the EU ETS is extended to all large organisations across the business and public sectors, meet or exceed the delivery of the existing package structure. However, from 2005 even the existing package delivers ~4MtC p.a. by 2010 and ~9MtC p.a. by 2020[11]. This is 75% of the total cost-effective abatement opportunity available using existing technologies out to 2020[12].

CO_2 emissions from the business and public sectors in isolation were, by 2000, already 19% below their 1990 levels, thanks to the structural changes and reforms of the 1990s. With the current CCP, this results in a saving versus 1990 emissions in excess of 20% by 2010 and 30% by 2020 for the business and public sectors. The Government has targets in place to reduce national emissions by these levels (60% cut-back by 2050 is equivalent to 30% by 2020). The business and public sectors can achieve these cut-backs, but the target is a national one, including both domestic

[11] Existing package delivers ~9MtC p.a. in 2020 in high scenario if CCL is maintained at current strength, rather than doubled.
[12] Total cost-effective abatement opportunity 11.7MtC, including the opportunity through building regulations, which is not included in the BRE abatement curve. Abatement curves also do not allow for additional opportunity expected through innovation. Building regulations generate an extra 3.8MtC p.a. (before policy overlays) over and above 7.9MtC p.a. indicated in Chart 4. Technical potential is likewise increased to over 16MtC p.a..

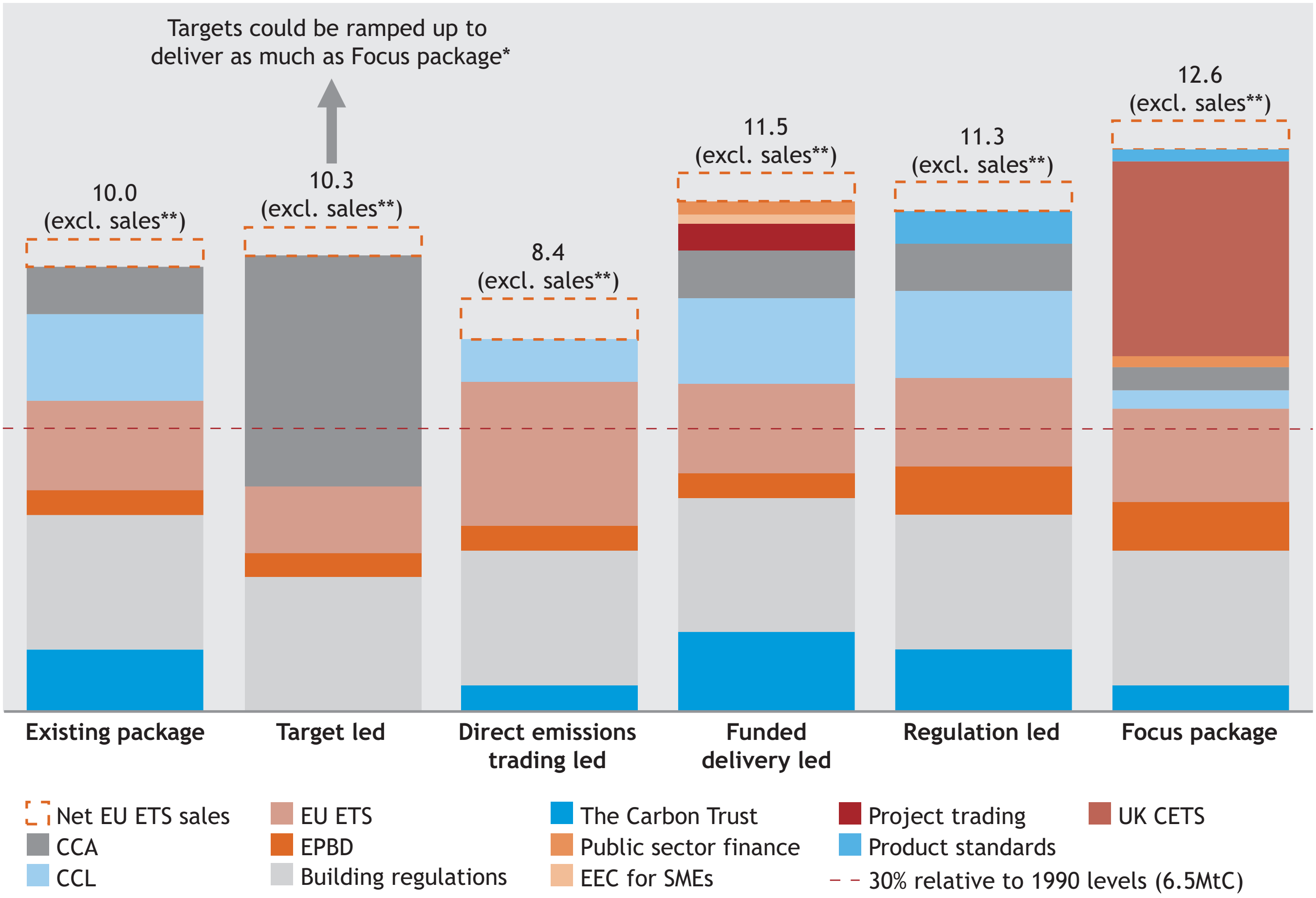
and transport emissions, which will both need to deliver much more if the overall target is to be met. Our aim here is to establish how much carbon can be delivered from the business and public sectors, cost-effectively and without creating adverse competitiveness effects. Further studies, performed by Government, the Energy Savings Trust and others will look at what can be achieved in other sectors. However, the fact that the existing package has only accessed 75% of the cost-effective opportunity available out to 2020 does imply that there is scope to go further in the business and public sector.

Indeed, the focus package delivers the most carbon of the packages under test at ~11.2-12.6MtC by 2020 (up to ~3.6MtC or 40% more than the existing package at its current strength). In the high scenario this is above the overall cost effective opportunity. This package, through the UK CETS, achieves savings above the cost-effective potential by exploiting a high proportion of all the opportunities up to the scenario price for carbon (but, as would be expected, it delivers less than the overall technical potential using existing technologies out to 2020[12], ~16MtC). Innovation would be expected over this period to have delivered a significant range of new cost-effective opportunities that would further assist the delivery predicted in this package.

To help distinguish differences between the various packages, Chart 25 gives the breakdown of the delivery of each package by instrument in our high scenario in 2020.

***Chart 25** Carbon delivery by instrument (high scenario, 2020)*

2020MtC p.a. saving vs. projected emissions (58MtC)***, allowing for overlaps in instrument coverage



- Focus package delivers most carbon as companies incentivised to abate to market price** (target led package could deliver more if targets were ramped up)
- Building regulations/EPBD and EU ETS are important components of all packages.

Note: *Targets currently set at 1% p.a. in line with original CCA agreements; **€30/tCO_2 EU ETS and UK CETS price, 1% p.a. allocation cutback in EU ETS, 100% auctioning in UK CETS. EU ETS direct delivery based on firms meeting their allocation cut-back – to be conservative, total delivery stated excludes any EU ETS 'sales' (top bars) that could be achieved by taking further abatement measures costing up to the market price; ***Allowing for CCP delivery 2000-2005 (3MtC).
Source: Ecofys.

[12] Total cost-effective abatement opportunity 11.7MtC, including the opportunity through building regulations, which is not included in the BRE abatement curve. Abatement curves also do not allow for additional opportunity expected through innovation. Building regulations generate an extra 3.8MtC p.a. (before policy overlays) over and above 7.9MtC p.a. indicated in Chart 4. Technical potential is likewise increased to over 16MtC p.a..

Key building blocks: building regulations and EPBD in buildings; EU ETS and CCA for energy-intensive industry

The first feature of note is the importance of building regulations and the EPBD across all packages as the primary routes to force change, increase the visibility of energy use and overcome the landlord–tenant divide in the building stock. Delivering together roughly ~3.5 to 4MtC p.a. by 2020, depending on the implementation of the EPBD, these two instruments make up at least 30% of all delivery across all the packages.

The EU ETS is also a key instrument delivering 1.5MtC p.a. in our 2020 high allocation scenario directly from the allocation cut-back (to the non-power sectors) and an extra 0.5MtC p.a. due to the elasticity reaction brought about by the associated increase in electricity prices in the existing package. As explained, this does not include the (larger) savings that could be expected from the impacts of the EU ETS on power sector fuel switching and price impacts on domestic energy use, or indeed the carbon intensity of other end-use electricity savings (Chart 10).

In practice, facilities in the EU ETS could adopt one of three strategies:

1 **Buy:** not abate, and buy allowances on the market to make up their full allocation shortfall. Most likely for companies with limited financial exposure or very limited focus on or opportunity for abatement in the time available

2 **Comply with allocation:** abate carbon to cover any allocation shortfall, but no further: avoid participating in trading market. Most likely for companies with low appetite or capacity for risk and trading, but with sufficient abatement opportunity to take up easiest savings

3 **Sell ('perfect foresight'):** take all available abatement opportunities up to the market price with a view to sell excess allowances. Most likely for firms with very good understanding and capacity to implement their abatement options, and which have confidence in the market price.

As described, both the economic models in this study assume 'perfect foresight', with sectors abating as determined by the general elasticities up to the market price. However, the bottom-up model, used to derive the figures in Chart 25 above assumes a 'comply with allocation' strategy and takes appropriate abatement measures from each sectors abatement curve. In the high scenario, if the sectors covered by the scheme were to react by abating carbon all the way to the market price of ~€30/tCO_2, an additional delivery of 0.6MtC p.a. could be achieved and the additional allowances sold on the market (or more in the EU ETS-led scenario).

Real behaviour may fall somewhere in between the three options indicated, but could be expected to evolve towards the 'sell' strategy as the market matures. Ultimately the abatement behaviour adopted will depend on a firm's financial exposure to the scheme (e.g. magnitude of allowance cut-back relative to total costs), its opportunity to abate, its trading expertise and its CSR strategy (some firms interviewed will not adopt a 'buy' strategy on the grounds that they would be seen by stakeholders (their investors, employees and customers) as not taking their share of action to combat climate change).

We can have confidence that, in the high case existing package scenario modelled, the EU ETS will deliver the ~2MtC p.a. associated with the allowance cut-back and electricity price rise. The CCA, by setting equivalent targets for these sectors, despite being double regulation, has the advantage that it ensures domestic abatement will occur. If this double regulation were removed and UK companies all adopted a buy strategy, the ~1.5MtC cut-back would still be achieved across Europe and according to Kyoto principles, count towards the UK's Kyoto commitment. This is, of course, extremely unlikely and firms are more likely to adopt, at the least, the 'comply' strategy.

The CCA is the next important element in the existing package, delivering an additional ~1MtC p.a. of carbon savings from the energy-intensive sectors it covers outside the EU ETS in 2020 (on top of the role it plays in backing up domestic abatement under the EU ETS as described earlier).

These four building blocks, building regulations, EPBD, EU ETS and CCA, constitute a great foundation for the business and public sectors' climate change policy package. All of the packages effectively attempt to provide an additional incentive or driver for change on top of these instruments, focusing on the less energy-intensive segments in the market which together make up more than 50% of business and public sectors emissions. Currently the CCL is the only economic instrument acting on these segments.

Creating further incentives or drivers for change across the less energy-intensive segments

Each package attempts to incentivise or drive change across the less energy-intensive segments using different instruments (in all cases the delivery is supported by the actions of the Carbon Trust) including:

- Existing package: CCL/CCTax
- Target led: CCA
- Direct emissions trading led: EU ETS-style trading
- Funded delivery led: project certificates, EEC for SMEs, public sector finance and increased Carbon Trust support
- Regulation led: product standards and stronger implementation of EPBD
- Focus package: UK Consumption-based Emissions Trading Scheme (UK CETS), strong EPBD and product standards.

In the target led package, the CCA is extended from the 44 energy-intensive sectors it currently covers, to cover all of the business and public sectors, including SMEs. This in theory is possible as targets are negotiated at a sector level and rolled out across all companies. However, this package, as modelled, delivers only marginally more than the existing package. The assumed targets, increasing at a rate of 1% p.a. from 2005 in line with the existing targets[13], ramp up to a maximum of ~15% saving by 2020 and deliver an additional ~4MtC p.a. by this time. However, assuming firms act only to meet their new targets, this additional delivery is all but netted off by the ~3.9MtC p.a. carbon delivery that otherwise would have occurred in the existing package from these sectors: ~2.5MtC p.a. due to price effects (~2MtC p.a. due to the CCL[14] and ~0.5MtC p.a. due to the EU ETS price effect) and the Carbon Trust (~1.4MtC p.a.), which now acts to support the delivery of the extended CCA targets. The targets under the CCA scheme could in fact be ramped up more aggressively than the 1% p.a. assumed here, to enable the target led package to deliver at least as much as the focus package in Chart 25. However, based on experience of sector-level target negotiations to date (in the existing CCA and EU ETS), it has proved politically very difficult to set stronger targets.

The direct emissions trading led package, where EU ETS-style trading is extended to cover all large organisations and the remaining SMEs pay the CCL only for direct fuel use, generates the lowest savings of all the options considered. A major reason is that the only remaining incentive to drive reductions in electricity use is the EU ETS price effect. Since electricity-related emissions make up 70% of the emissions across the less energy-intensive segments, this leads to a significant sacrifice in carbon savings (package overall delivers ~8.4MtC p.a. in 2020, ~1.6MtC p.a. down on the existing package in our high scenario). Whilst this package is by far the simplest of all those examined, it highlights the need to focus on electricity-related emissions when targeting less energy-intensive sectors. In addition, we have assumed that the practice of mostly free allocations is also extended across other sectors. Outside of power generation, much effort has been expended on the debates surrounding allowance allocations, to enable covered installations to continue 'business as usual' operations. If this focus does not shift to seeking to actively abate and sell, and is extended across other sectors, the result would be the low 'without sales' delivery indicated in Chart 25.

The funded delivery package uses a series of specific instruments to deliver an additional ~1.5MtC p.a., over and above the existing package in 2020. The key components of this change are project certificates (~0.6MtC p.a.); increased Carbon Trust support (~0.4MtC p.a.); public sector finance (~0.3-0.4MtC p.a.) and EEC for SMEs (~0.2MtC p.a.). The project certificate scheme for large organisations has a number of significant disadvantages, notably as described earlier it is complex, expensive and its impact is limited by the fact that it is limited to specific capital-related projects. On this basis we believe there are better alternatives to incentivise change in its target market. On the other hand, whilst the EEC for SMEs measure delivers the lowest overall carbon saving, it may well be an applicable means of addressing buildings-related emissions from small businesses, who are difficult to influence as they are numerous, diverse and are generally focused on other issues. The other two initiatives, the Carbon Trust and public sector finance, can be considered enablers within these scenarios, overcoming information and financial barriers.

The regulation led package likewise delivers more than the existing package, on this occasion due to the introduction of product standards and strengthened implementation of the EPBD. Minimum product standards deliver an additional ~0.7MtC p.a. and the strengthened EPBD ~0.6MtC p.a. in our 2020 high scenario. Both are very viable routes to improve the energy efficiency of existing buildings, removing poor equipment from the market-place, and increasing the visibility of energy use and the opportunity for improvement.

Finally, the focus package delivers the most of all the packages under test, principally by combining the best elements of all the packages described. The lead instrument for large organisations is the UK CETS, which, by including electricity, overcomes the issues associated with the extension of the EU ETS described here. Furthermore, this package also incorporates the improvements in the regulation led package: product standards to drive change in SMEs and the strengthened EPBD. Key enablers, such as the public sector finance scheme, are also included. Allowing for overlaps[15] this package delivers ~11.2-12.6MtC p.a., driven principally by the UK CETS, which delivers ~5.4MtC p.a. by 2020.

The UK CETS, is assumed to deliver carbon savings costing up to an assumed market price of €30/tCO_2 in our high scenario, equivalent to the cost of the CCL (in the high scenario in which the CCL is assumed to be doubled). The low scenario, where we keep the CCL at its current level and assume a market price of €15/tCO_2 by 2020, has very little impact on the UK CETS savings which remain at ~5.2MtC p.a. in 2020. These savings, at ~25% of the targeted emissions, are aggressive but realistic given the significant abatement opportunity available in non-energy-intensive sectors, particularly in buildings. The price of carbon pushes delivery beyond the potential that is cost-effective at baseline energy prices. Companies are not exposed to any additional financial burden as we assume they are provided with a rebate on the CCL on entering the scheme — it is, however, the increased visibility of emissions under the UK CETS (linked to improved metering and consistent financial reporting), combined with the auction, that drives additional abatement compared to that expected due to a price effect alone.

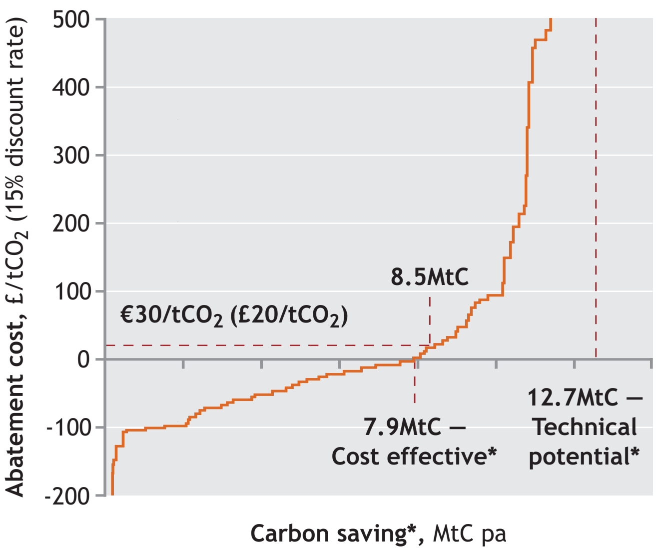
[13] CCA cutback assumed to ramp up at 1% p.a. vs. business as usual emissions, in line with current CCA targets i.e. by 2020 targets can go beyond cost-effective opportunity, but limited to, at maximum, the full level abatement achievable in the sector in question. [14] Based on double existing CCL rate in high scenario: saving due to CCL would be ~1MtC p.a. in 2020 at existing rate. Firms are given an 80% rebate on the CCL if they meet their CCA targets. [15] CCL, Carbon Trust, EPBD and product standards delivery additional only for SMEs not covered by the UK CETS; public sector finance enables UK CETS delivery from public sector, i.e. is non-additional.

One further refinement included in the focus package is the removal of double regulation for energy-intensive organisations. This is achieved by folding current CCA sectors outside the EU ETS into the EU ETS after 2010 allowing them to maintain their CCL discount – in practice, it may make more sense to fold some sectors into the proposed UK CETS. The net impact on emissions is a marginal increase of ~0.1MtC p.a., which is potentially a reasonable sacrifice, given the associated reduction in the administrative burden for the firms involved. This increase is largely associated with the electricity emissions that were controlled by targets under the CCA, since direct emissions would be covered by the EU ETS allocation cut-backs. The net impact on carbon delivery is so low because the loss of carbon savings achieved through negotiated targets on electricity use is all but offset by the impact in these sectors of the EU ETS-induced rise in electricity prices by 2020, which is important given the relative sensitivity of these energy intensive sectors to energy prices (see Table 4).

Clearly, a range of instruments are required to overcome the different barriers to change across the business and public sectors. Building regulations and the EPBD should form the lead in the buildings sector. Whilst the CCAs and EU ETS, (particularly in the longer term when strong caps and associated higher prices are developed), should provide strong incentives for energy-intensive organisations. The UK CETS appears to be the most effective means of further incentivising the less energy-intensive sectors, potentially supported by product standards or even an EEC for SMEs and interest-free loans to deliver change across small

Chart 26 *Business and public sector abatement curve*

2020 abatement cost curve for the business and public sectors



Note: *Carbon saving from existing measures only, does not include opportunity in new builds and refurbishments accessed through building regulations (increases total cost effective opportunity to 11.7MtC and technical potential to over 16MtC), also does not include innovation.
Source: Ecofys analysis based on BRE and ENUSIM abatement curves.

businesses. Strengthening the existing package in this manner could deliver an additional ~1.1-1.5MtC p.a. in 2010 and ~2.2-3.6MtC p.a. in 2020 from the downstream savings in business and public sector energy use.

3.2 Costs, competitiveness and macro-economic impacts

The modelling approaches introduced in Part 2 of this study – bottom-up technology curves, sectoral modelling, and two forms of macro-economic modelling – shed different perspectives on the costs and benefits of the various options for reform of the UK CCP. This section sets out the quantified economic findings in terms of these different perspectives, and then draws some cross-cutting conclusions about the economics of CO_2 mitigation under the next phase of the UK Climate Change Programme.

Bottom-up technology perspectives

Analysis with the bottom-up models, that underpin the cross-cutting analysis of carbon delivery in Section 3.1, translates the technological opportunities identified in abatement cost curves into delivered carbon and financial impacts. Chart 4 summarises the estimated cost-effective potentials, and Chart 26 plots the full marginal abatement cost curve for the business and public sectors out to 2020 – i.e. the abatement opportunities in order of cost, starting with those that create the biggest net benefit (negative cost).

Given specific assumptions about which parts of the cost curve are exploited in response to the incentives in a given package, this data enables a financial cost-benefit to be calculated. In costs we also include an estimate of administration costs to Government, though these are eclipsed by the scale of investments required, and the benefits which comprise the energy savings to firms and other cost savings associated with modernising equipment and changing behaviours.

From this perspective, all the policy packages modelled result in aggregate net benefits, as the energy cost and other savings outweigh the investment required plus administration costs. Indeed, the net benefit is orders of magnitude greater than the estimated administrative cost to Government.

This reflects the fact that most of the abatement stimulated by the packages draws upon technologies that are themselves cost-effective (at baseline projected energy prices and a cost of capital of 15%). In aggregate, over and above projected 'business as usual' take-up, the abatement curves suggest a total cost-effective opportunity available out to 2020 using existing known technologies of 11.7MtC p.a. (the 7.9MtC p.a. cost effective potential in Chart 26 is increased to 11.7MtC p.a. by opportunities in new builds and major refurbishments accessed through building regulations that are not included in the abatement curve).

The focus package delivers most out of all the packages investigated, but even this only slightly exceeds the cost-effective potential, delivering ~11.2-12.6MtC p.a. in 2020. In practice, innovation would be expected to increase the available opportunity significantly over this period.

Under these circumstances, Chart 26 indicates that the vast majority of the abatement measures taken out to 2020 create significant benefits; the average potential benefit across the various packages is in the range ~£30/tCO_2 to ~£70/tCO_2. The capital investment required to achieve the projected carbon savings totals about £5bn out to 2020 in the focus package (NPV, discounted at 15%).

Comparisons of cost-effectiveness across different packages depend upon assumptions about which parts of the abatement curve firms utilise; since firms are not implementing cost-effective measures at present, due to the various barriers discussed, it cannot always be assumed that they start with the cheapest irrespective of the policy package. Our focus package is designed to try and get the most delivery by utilising all parts of the abatement cost curve, thus the issue of ordering the measures is secondary.

From an economic perspective this raises many questions. Some of the reasons why companies do not already invest in these opportunities were addressed in discussing barriers in Section 1.2.

To the extent that measures are not implemented due to hidden costs — for example the transaction costs associated with the time required to investigate abatement options and downtime required to update systems to the new ways of working — these would erode some of the estimated benefits. Enviros, have analysed the impact of hidden costs on abatement curves and found that the cost-effective abatement opportunity could be reduced to up to a third if high unaccounted costs are assumed (they found far weaker impact in their low cost scenarios). However, this still leaves, even in this high cost case, a substantial abatement prize that also can generate economic value.

In addition to the other barriers described in Section 1.2, it is also possible that firms are capital constrained and simply have higher value activities to undertake. However, not all firms are faced with credible opportunities to invest at more than 15% rates of return, nor are they necessarily constrained from borrowing at interest rates that would make such energy-saving investments profitable. Principally, it is the additional barriers described earlier that impede the uptake of cost-effective energy efficiency measures. There may be situations where firms could potentially have used this capital more productively, but on the whole over the period under study, bottom-up analysis indicates that carbon abatement investment can create a net benefit rather than a cost, if policy can successfully raise awareness of the opportunities and overcome the barriers that currently impede such action.

Revenue flows in specific markets: Cournot modelling

It still does not necessarily follow that firms benefit from the policy packages, because the policies all also create financial flows between Government, industry and consumers. Indeed, with the current structure of the CCP, the CCL raises close to £1bn/yr and with doubled CCL — an annual tax take approaching £2bn/yr — the investment of £5bn (discounted @15%) required to deliver the full theoretical potential out to 2020 would be eclipsed by the financial transfers, over £13bn (similarly discounted). This tax take is, however, currently recycled to the business and public sectors, in the form of reduced national insurance contributions.

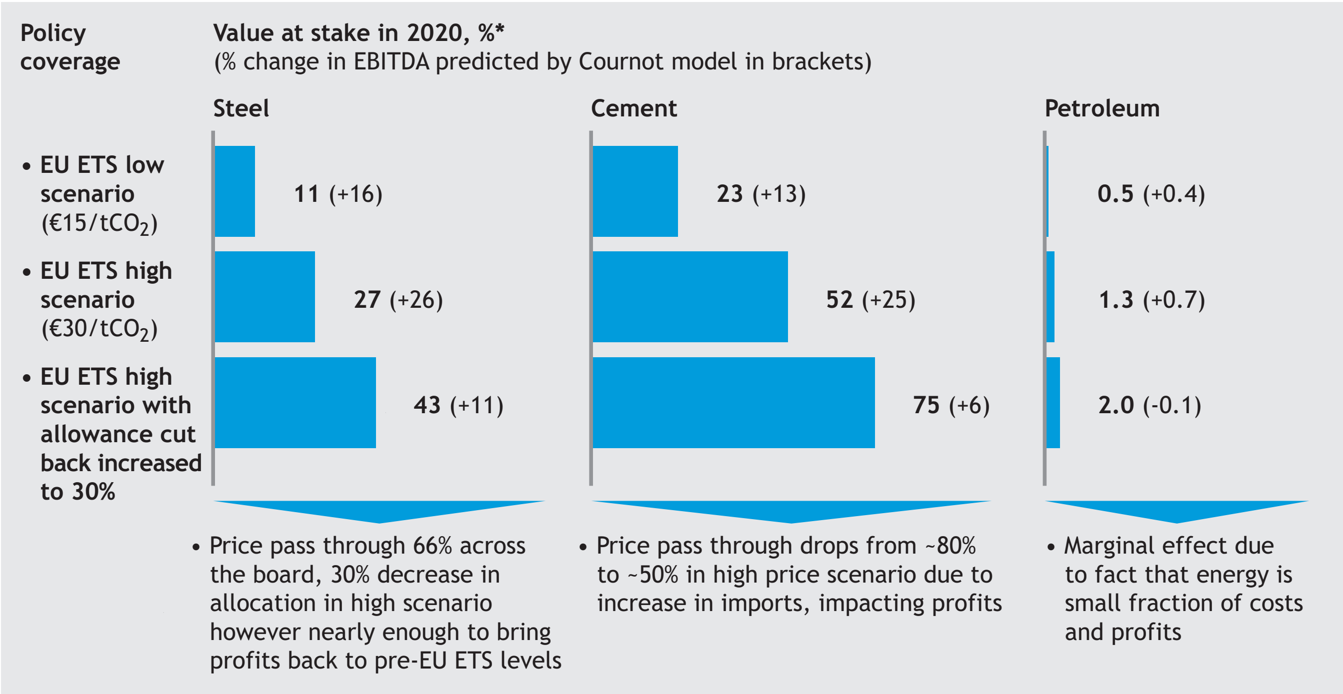
The financial transfers associated with tax instruments are a principal reason why industry tends to prefer emissions trading; the incentive impacts on marginal investment are similar, but if allowances are given out free they do not transfer money to Government.

The net effects on firms will depend on how the resulting carbon allowance prices affect their product pricing decisions. This is the topic of Cournot modelling, the second of the modelling perspectives that we employed. Extending the analysis we published in 2004 (Carbon Trust, *The European Emissions Trading System: Implications for Industrial Competitiveness*), and as summarised in Part 2, the model was extended to include additional sectors, to reflect the cumulative cost of the different instruments in the different packages, and to separate EU from non-EU competition.

The results for key EU ETS and CCA sectors are illustrated in Chart 27 and Chart 28. These show impacts on input value at stake[16] and, using this more developed version of the Cournot model of sector pricing behaviour, the net impact on EBITDA (earnings before interest, tax, depreciation and amortisation). The micro-economic analysis again suggests that sectors have potential to profit from the way that the revenue increases associated with marginal pricing in the market, combined with the value of free allocation, would more than offset cost increases. Although, as highlighted in Section 2.2, even if sectors were unable to pass sufficient costs through to generate the profits predicted, most would be unlikely on the whole to lose out in the short term as only small price rises are likely to be required to maintain current profits (aluminium smelting being the notable exception). However, in reality, cement and steel may begin to struggle to maintain current profits for the products considered in the longer term, as the product price rises of 10% and 5% respectively in our high 2020 scenario may be difficult to achieve on top of shifts in other fundamentals driving these markets.

[16] Value at stake = (increase in total costs after allowance allocation)/(starting earnings before interest, tax, depreciation and amortisation (EBITDA)).

***Chart 27** Impact of EU ETS on profitability of core EU ETS energy-consuming sectors*



Insights

- Steel has high value at stake but is able to pass costs through in all scenarios
- Cement imports in high price scenario, reduce cost pass through, but profits maintained
- Impact is marginal on petroleum.

Note: *Value at stake = (increase in total costs after allowance allocation)/(starting EBITDA); high variant scenarios with CCL doubled; carbon price of €30/tCO_2 and cut back of 1% p.a. versus business as usual projected emissions.
Source: Oxera.

The Cournot modelling predicts that the electricity sector continues to make substantial profits from the EU ETS under all the scenarios we modelled. The Cournot model also continues to predict that all the EU ETS sectors profit even under our high price scenario with 15% allocation cut-back. This is achieved as the Cournot model predicts that the sectors, if pricing is rationally based on the increase in the marginal cost of production and the import/export balance, would increase prices beyond the level required to merely maintain current profits as described above and in Section 2.2. It takes allocations 30% below projected 'business-as-usual' emissions to wipe out the gains of both steel and cement in the Cournot modelling, returning their profitability towards pre-ETS levels, and to push petroleum refining to a small loss (though only 0.1% fall in EBITDA).

For sectors outside the EU ETS but in the CCAs, aluminium smelting, as indicated, is uniquely exposed if it uses electricity from the grid. The impacts on other CCA sectors investigated, brewing and car manufacture, are generally smaller in magnitude than for those in the EU ETS (EBITDA impacts all below 1% in 2020 under CCA), and are negative reflecting the inability to profit from free allocations. Both sectors are predicted to gain slightly (up to 3% gains in EBITDA in 2020) if they were to move into the EU ETS or a trading scheme encompassing their electricity emissions, when provided 85% of their allowances for free. However, the value at stake in both these scenarios remains small, under 4% of EBITDA.

Less energy-intensive sectors, such as grocery retail and hotels, were also found to be marginally impacted by the policies under investigation. These are both currently exposed to the full CCL. They would not necessarily be exposed to any additional financial burden if they were to be entered into the UK CETS trading scheme described in Section 2.4, in which all direct and electricity-related emission allowances are auctioned, if a corresponding rebate on the CCL were provided. However, taking the effect of the UK CETS in isolation, if all allowances were auctioned, grocery retailers and hotels would only need to raise their prices marginally to maintain current profits in our high scenario. In grocery retail, price rises of 0.1% in 2010 and 0.2% in 2020 are required, and for hotels, rises of 1.1% in 2010 and 2.2% in 2020. Given that these are both domestic markets, they would be expected to be able to pass these small price rises through to consumers without damaging their profitability.

Overall, the results tend to reinforce the conclusions of our earlier study. In addition to electricity, all the industry sectors participating in the EU ETS should, according to economic theory, increase profitability under our scenarios because the net cost exposure associated with increased electricity prices and 15% allocation cut-back is smaller than the revenue gains from product price increases associated with carbon pricing throughout the economy. In broad economic terms, the carbon constraint creates a 'scarcity rent' and emissions trading allows industry to capture the largest part of these rents. In reality, beyond isolated sectors, it is very unlikely that any sectors will lose out due to the policies investigated here, as only small price rises are required to offset the increased costs incurred. Ultimately, it is the consumer that pays due to the changing cost structure. This brings us to the third perspective, looking at aggregate impacts from a macro-economic standpoint.

Chart 28 *Impact of EU ETS on profitability of sample CCA sectors*

Policy coverage	**Value at stake in 2020, %*** (% change in EBITDA in brackets)	
	Brewing	**Car manufacture**
• **As is (CCA)** – value at stake created by increase in electricity prices due to EU ETS	**1.5** (-0.3)	**1.7** (-0.6)
• **Trading covering direct emissions only**	**2.9** (+2.0)	**2.9** (+2.2)
• **Trading covering all emissions**	**3.5** (+2.5)	**3.4** (+2.8)

- Brewing and car manufacture not under significant threat – more concerned about second order effects on input prices (steel and aluminium in car manufacture).

Note: *Value at stake = (increase in total costs after allowance allocation)/(starting EBITDA); high variant scenarios with CCL doubled; carbon price of €30/tCO_2 and cut-back of 1% p.a. versus business as usual projected emissions.
Source: Oxera.

Macroeconomic perspectives

The third perspective is macroeconomic, in two quite different forms: macro-equilibrium modelling, and macro-econometric modelling. The approaches differ from the microeconomic modelling presented in at least three fundamental respects:

- They are based upon estimated behaviour of economic systems, not detailed microeconomic analysis of specific technologies or sectors
- They use historical data to estimate the functions that determine model behaviour
- As the name implies, they model the whole economy, so as to capture interactions between different parts of the economy.

For example, the Cournot sector studies of the EU ETS suggest that many individual sectors could stand to profit from its introduction, because the EU ETS tends to raise consumer prices by more than it raises production costs. Even if they lose some market share, most domestic producers gain more from the price effect than they lose from the increased costs or losses to importers and their profitability rises; it is consumers that pay. A macro-economic study would in principle capture all these effects together, including the wider implications of higher prices of some products feeding through to others, and the knock-on impacts to aggregate consumer expenditure.

In other respects, however, the two macro approaches we employed are very different from each other:

- The model employed by Oxford Economic Forecasting (OEF) represents economic production driven by four main categories of inputs – labour, capital, energy and others – in terms of a 'production function' derived from classical economic theory. Using this, the economy establishes an equilibrium subject to the constraints on and costs of these inputs, and through this it represents the impact on productive potential of the increases in energy costs implied by our scenarios
- The model employed by Cambridge Econometrics traces the past impact of energy price and policy changes and projects forward the impact based on an econometric analysis of annual data 1971-2002, e.g. in the form of the traditional energy demand equations, without assuming full employment.

Within the general uncertainties and constraints (notably, the fact that the CE model incorporates electricity production whereas OEF take emission factors externally), the carbon delivery from economic instruments is reasonably comparable, as discussed in Section 2.2: for example, strengthening the current Climate Change Programme, and specifically doubling the full-rate CCL across all the non-energy-intensive sectors (with the current CCP structure), saves 3MtC in the CE model and 2.5MtC in the OEF model in 2010.

In terms of economic impacts however, the results are quite different. Both analyse their economic results in terms of the gross impacts of the different packages on the Gross Value Added (GVA)[17] of the different major sectors, but predict very different impacts of higher prices and structural changes to the packages. In the OEF model, CO_2 mitigation generally involves a trade off between carbon reduction and economic production, whereas the CE model does not. For example, with the current Climate Change Programme structure, in 2010, the OEF model produces a loss in GVA of 0.3% in our high scenario and 0.1% in the base (low price) scenario, whilst the CE model predicts essentially no impact on GVA (0.01% loss in the low price scenario, and 0.01% gain in the comparable higher price scenario). The losses in the OEF model are a bit more than twice as high when measured at market prices[17], or when the scenario is extended (with rising EU ETS prices) to 2020.

In the OEF model:

- The trade-off is much greater in the energy-intensive sectors than in the non-energy-intensive sectors. In the worst case by 2020, the energy-intensive sectors lose about three times as much GVA (in percentage terms) as the non-energy intensive sectors. This finding would tend to reinforce our suggestion that the non-energy-intensive sectors are appropriate as a greater focus for the next phase of UK climate change policy
- The exception is the targets led packages. For these, to the extent that instruments like the CCAs do stimulate greater investment in these sectors — modelled as increasing the rate of return on their capital investment — this may do much to offset the economic losses, but at the cost of undoing much of the emissions savings.

For the Cambridge Econometrics model, in contrast, this underlying trade-off between CO_2 mitigation and economic output disappears. As noted, the current CCP high price scenario has negligible impact on GVA, whilst other packages increase GVA significantly:

- Across the other packages, economic output (whole economy GVA) increases by 0.25–0.28% in 2010, and the increase is relatively independent of price
- The large energy-intensive sectors gain the most, generally adding about 0.6% to their GVA in 2010, whilst the non-energy intensives gain around 0.12%.

Also in the CE model, carbon savings are more sensitive to the specific scenario than are GVA impacts, whilst both tend to be sensitive to price more than specific packages in the OEF model.

The models are both complex, but clearly some explanation is required to understand such different economic results. Initial exploration points to two main factors:

(a) Whether or not revenues raised by economic instruments can be used productively

In the CE model, revenues raised by instruments such as the Climate Change Levy (CCL) and auctioning UK CETS allowances are returned to business through equivalent reductions in employee National Insurance Contributions (NICS) reflecting the original agreements made when the CCL was introduced. The result is a revenue-neutral switch for business as a whole, with some redistribution towards the more employment-intensive sectors. Given the labour market representation in the CE model, this reduced cost of employment creates an additional 5,000-50,000 jobs, depending on the scenario. This increased employment in turn helps to boost GVA.

The OEF model does not include any explicit use of the revenues raised by the economic instruments; rather, it measures directly the distortionary effects of higher energy prices. If revenues are returned to consumers, in classical economic theory this would not help economic production. In this model also, the labour supply is fixed so that any return of revenues in the form of reduced employer taxes would not increase employment, making it unclear whether or by how much revenue recycling would actually offset the negative effects. In the OEF model, therefore, energy taxes and emission trading reduce production by raising the price of energy, without the possibility for offsetting effects on production (in the long term) from any recycling of the revenues back into the economy.

(b) Awareness and investment effects

A second major explanatory factor may be whether and how non-price aspects of various instruments are represented. The CE model has an 'awareness effect' associated with the Climate Change Agreements, and for the targets extended package OEF introduce a corresponding rate of return increase to stimulate extra investment in the sectors covered by such target-based agreements. This increase in investment explains the GVA gains in the OEF model in the Targets Extended package and this parallel treatment probably explains why the results of the two models differ least for this particular scenario.

For the direct emissions trading led and the focus package, the extension of new instruments (respectively, the EU ETS and the UK CETS) across non-energy-intensive business, makes results very sensitive to how they are modelled. OEF model these purely in terms of price impacts on productive potential. However, Cambridge Econometrics include an awareness effect impact on energy use, with some increased investment that reduces their energy costs, resulting in net gain. The awareness effect is a one-off impact independent of price, and since revenue impacts of higher prices are returned to these industries (in aggregate) through NICs reductions, this may explain why the scale of gains is relatively insensitive to price.

[17] Gross Value Added impact, a proxy for GDP impact when reported for the whole economy, is reported at factor cost in the first instance, i.e. net of taxes etc. in accordance with Government guidelines to exclude purely transfer payments in macroeconomic assessments.

Thus, these two factors in combination – whether or not revenues raised by economic instruments are or can be returned to industry in ways that assist their productive capacity, and whether or not industry responds to new instruments by depressing its output or by discovering new previously unconsidered opportunities for energy savings – probably help substantially to explain the divergence in economic results between the models.

Other effects and ways forward

Whilst these two core differences may explain a major part of the difference in results, there may be other important factors arising from the fundamental differences in results and core assumptions. As explained, general equilibrium models (such as the OEF model) are built upon the core assumption that economies operate by fully utilising resources in least-cost ways. Econometric models like the CE model, in contrast, do not impose assumptions about resource utilisation or optimality, but rather try to model the dynamic impact of various changes as they flow through the economy on the basis of econometric evidence about how comparable changes appear to have affected things in the past.

It is obviously unsatisfactory to have a situation in which models predict the whole economic impact of different packages to be so different. In the most extreme case, each model predicts an impact for the 'Focus High' package of over 0.25% of GDP, but disagree as to whether this would be the scale of gain or of loss, a total difference of over £5bn by 2010. We have indicated some of the likely explanatory factors, and suggest in particular that assuming that billions of pounds of revenues on the one hand cannot be put to any productive use, or on the other may help to fuel a substantial economic and employment boost that more than offsets any original losses, both deserve further scrutiny. But at present the relative importance of this vis-à-vis other differences (e.g. in relation to awareness effects) remain unclear. To clarify this, the Carbon Trust is embarking upon a successor study with the consultants to more fully understand and reconcile the different perspectives, and also to reconcile the macro-economic views with the gains to industry predicted by the bottom-up and the Cournot modelling perspectives.

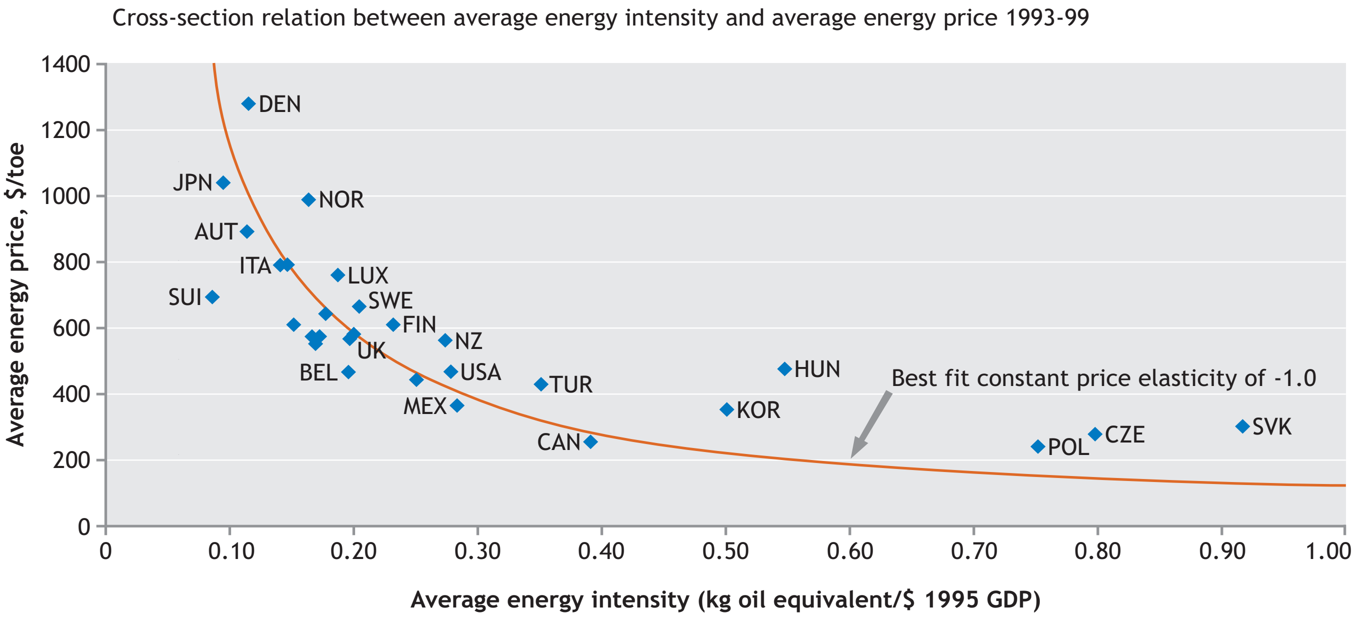
A longer-term perspective on energy prices

Finally, and beyond the specifics of economic modelling, international comparisons shed important light on the possible longer-term impacts of rising energy prices including the possible impacts of CO_2 abatement policies. Chart 29 shows the observed relationship between aggregated final energy prices and energy intensity.

Within this, the transition economies of eastern Europe and the former Soviet Union are outliers with abnormally high levels of energy dependence for their domestic prices. Excepting these, the most interesting feature is that the implied 'elasticity' of energy intensity is about -1.0 – i.e. countries with 10% higher average national energy prices consume about 10% less energy. As a result, it appears that total national consumer expenditure on energy is remarkably constant, irrespective of domestic taxes and resulting price differences.

Whilst this does not in itself determine the national economic implications, it does at least suggest that steadily rising energy prices will not necessarily lead to increased

Chart 29 *Relationship of energy price to energy intensity in different countries*



Source: World Bank online database (www.worldbank.org/data/); Newbury (2003) 'Sectoral dimensions of sustainable development: energy and transport', Economic Survey of Europe 2003, No.2, Chapter 3, 73-93.

national energy expenditures, given time, as these data suggest that rising prices in the longer term may be offset by roughly equivalent and offsetting increases in energy efficiency. The relationship between these international data and the national short-to-medium-term elasticities set out in Table 4 is another topic that could be usefully subject to further exploration.

3.3 Implementation

The carbon reductions achievable from the business and public sectors will only be realised if both the existing and the suggested new policy instruments highlighted in this study are well implemented. This final section considers issues in implementing each of the main instruments that we have concluded could contribute to an effective package:

- Building regulations
- European Performance of Buildings Directive (EPBD)
- EU ETS and Climate Change Agreements (CCAs)
- UK Consumption-based Emissions Trading Scheme (UK CETS)
- Supplier-based Energy Efficiency Commitments (EECs) for SMEs
- Other instruments: interest-free loans for SMEs; the Carbon Trust; product standards; public sector leadership.

Building regulations

Strong enforcement and compliance will be required for building regulations to deliver their full potential. The Carbon Trust's experience indicates compliance problems at each of the stages of design, construction and operation. Reasons for weak compliance include lack of designer/builder understanding/training in the regulations and the available solutions, building trade emphasis on minimising upfront costs rather than life cycle costs, and a lack of testing of actual performance. Even buildings that pass the regulations by reaching nominal design criteria (e.g. level of insulation) can fail to meet expected performance levels due to errors in construction (e.g. gaps in insulation) or subsequent change of use or poor maintenance.

We are not aware of any studies on overall compliance levels in the non-domestic sector or even on the scale of monitoring. Until recently, it was common knowledge across the industry that buildings weren't being tested for air-tightness. Consultants providing air-tightness testing for the industry suggest a recent increase in testing, but there are still no comprehensive statistics on this. One study completed in the domestic sector, of 99 dwellings, found that 30% of the buildings investigated failed to meet required air permeability standards[18].

Improving enforcement and compliance will require the relevant parts of building standards (Part L/J) to be given greater priority by building inspectors, probably with dedicated Part L/J inspectors for large buildings (>1000m^2). As energy performance issues are often not rectifiable after the building has been constructed (e.g. building fabric changes such as materials used and insulation design), it makes it even more important that inspectors are stringent at the design and construction stages.

Consequently, in addition to greater support and inspection, Government needs to review sanctions for non-compliance with Part L/J to ensure that they give strong incentives to comply. Finally, related activities need to build confidence in the market that viable solutions exist, and to build capability through wider demonstrations of low carbon buildings and awareness-raising campaigns. The case for much stronger building standards has already been accepted: given the scale of the potential carbon savings (up to 3MtC by 2020), the very high cost-effectiveness of these savings, and the enormous longevity of buildings once constructed, this now needs to be matched by stronger monitoring, support and enforcement.

Energy Performance of Buildings Directive (EPBD)

The EPBD is a European Directive that enters into operation in January 2006. The Directive mainly targets existing buildings and makes transparent their energy performance, as well as ideas for improving performance. As described in Section 2.3, it requires qualifying buildings to obtain (1) an operational rating of the buildings' energy performance in use which it must display and; (2) an asset rating of the buildings' intrinsic structural energy performance. The former is most relevant to the tenant (or user), the latter to the landlord (or owner).

At the time of writing, UK interpretation and implementation of the EPBD remains unclear, but both will be very important in determining its ultimate impact.

Interpretation: what is a large, public building?

The Directive applies (Article 7.3) to buildings with 'a total useful floor area over 1000m^2 occupied by public authorities and by institutions providing public services to a large number of persons and therefore frequently visited by these persons…'. Focusing on large buildings has the potential to be highly cost-effective: in total, buildings over 1000m^2 (excluding industrial buildings and warehouses) account for 70% of CO_2 emissions from non-domestic buildings, from just 6% of the stock by number. However, Chart 30 shows that differing interpretations could in the extreme alter the total building floor area covered by the Directive by a factor of more than three.

A narrow definition would capture only publicly owned buildings providing a public service, which would fail to engage any opportunities from the private sector, omitting in particular activities such as retail, hospitality, etc.,

[18] BRE report for Energy Savings Trust, *'Assessment of energy efficiency impact of Buildings Regulations compliance'*, November 2004.

***Chart 30** Potential interpretations and corresponding coverage of EPBD ratings*

Interpretation	Definition	Resulting coverage
Narrow public estates definition	Buildings >1000 m² owned or occupied by public sector	~40,000 buildings; ~200 million m² floor area
Public access definition	All buildings >1000 m² regularly used by public including retail, hospitality, etc.	~65,000 buildings; ~440 million m² floor area
Comprehensive definition	All buildings >1000 m² except industrial buildings and warehouses	~110,000 buildings; ~760 million m² floor area

Source: Ecofys analysis, BRE data.

which are heavy emitters of CO_2. A wider definition would provide valuable information that could also support implementation of some of the other instruments considered in our analysis. Widening interpretation further to cover all large buildings over 1000m² (except perhaps industrial buildings and warehouses, or others requiring security clearance) would maximise its coverage and potential. In terms of carbon, if operational ratings were just applied to the public sector only ~0.2MtC p.a. would be saved by 2020, whilst a comprehensive interpretation would increase the impact to ~0.6MtC p.a. (see Section 2.3).

Obligation: utilising asset ratings

The other key opportunity is to make some improvement in asset rating obligatory. As it stands, the EPBD is purely about requiring information on the energy performance and identification of energy saving recommendations: in itself it does not require any energy-saving action. In particular, asset ratings risk becoming simply another part of the paperwork of a property transaction rather than a tool used by landlords to improve performance.

One option to capitalise on the generation of asset ratings would be to require landlords to take up key cost-effective measures recommended on a certificate, perhaps through requiring a percentage improvement between successive certifications or by defining as part of the certification a sub-set of measures that have to be implemented, before any subsequent rating can be approved. As an up-to-date ('not older than 10 years' in the Directive) asset rating will be required for any subsequent sale or re-lease, the transaction could not proceed without the new rating. Such adjustment to the certification process may require new legislation, but could conservatively be expected to increase the impact of asset ratings in 2020 from 0.4MtC p.a. to 0.7MtC p.a. (Section 2.3). A similar approach could be considered to require improvement in operational ratings over time.

Implementation costs, focus and phasing

Finally we consider a number of commonly voiced concerns about such wider interpretation of the EPBD.

'Requiring wider display of energy performance certificates could reduce the value of the UK's property stock.' There will be no fundamental change in the supply of, or demand for, non-domestic buildings in the UK. Increased information in the market-place as a result of energy performance certification may cause differentials to occur between higher and lower energy performance buildings – that indeed should be part of the purpose – but the overall value of the stock should remain unchanged given that there is no material change to the overall supply/demand balance.

'The cost of obtaining an energy performance certificate is penal to property users.' There will be a cost associated with certifying buildings, that will be borne by the building owners/occupiers. Our analysis indicates that this will be much more than offset by the energy saving value of the consequent cost-effective energy efficiency measures.

'The cost to Government of assessment under the wider interpretations will be prohibitive.' Assessment capacity and cost is a real issue because of the inclusion of all non-domestic buildings in asset ratings, rather than because of the definition of public buildings used in operational ratings.

Assessment for *asset ratings* of large buildings (>1000m²) could take three to four days each. As ~10% of the existing stock are sold or re-leased each year, around 11,000 large buildings will require asset ratings annually; we estimate this could take ~40,000 man-days, or ~170 Full Time Equivalents (FTEs). However, even if simplified procedures enable certification of smaller buildings to take a day or less, certifying the remaining 170,000 smaller buildings sold or re-leased each year could take ~170,000 man-days or ~750 FTEs – a significant resource. One simple solution could be to focus asset ratings initially on large buildings, which as indicated dominate emissions, and only extend to smaller buildings if and as the assessor capacity and efficiency of rating processes improve over time.

Operational ratings, reflecting actual energy use, will require far less resource. If based on an on-site audit, each large building should take on average one day to be certified. Around ~100 FTEs would be required to certify all buildings covered by the wider definition of public buildings, including retail, hospitality, sports, if implemented over three years to 2009. Implementation of operational ratings could also be phased, starting with public sector buildings for the first two years (2006 and 2007), to allow time for learning and capability building, before roll-out to private sector buildings used by the public in the following year (2008) and then finally to all large non-domestic buildings (>1000m^2) from 2009.

More assessors will be needed, but the costs are small compared to the energy savings, and key to the transition will be to ensure that the rating and labelling process is well managed and that implementation is appropriately phased.

EU ETS and Climate Change Agreements (CCAs)

The EU ETS and CCAs are powerful means of incentivising change in energy-intensive industry, whilst minimising competitiveness impacts. In the EU ETS this is achieved, at least in part, because the scheme goes beyond just the UK, covering all EU 25 member states to create, ideally, a level playing field across a wide geography. Like the EU ETS, the CCAs also reduce the financial burden on companies by providing a rebate on the CCL, in this case in exchange for meeting carbon delivery targets.

However, there are implementation issues that could limit the delivery of both instruments in isolation, and there is a long-term need to remove overlap between the two instruments to reduce the administrative burden on companies. We consider removing this regulatory overlap to be a long-term, rather than short-term goal for two reasons: the EU ETS coverage and CCA agreements are already defined out to 2012, so the administrative gains from removing existing CCAs would be modest; and as in the near term the CCAs act as a useful backstop to ensure that domestic abatement occurs even if the EU ETS prices and allocations prove to be weak in its early phases.

The factors that inject uncertainty about the EU ETS relate to the way in which targets are set, inconsistencies in allocation procedures between countries, perverse incentives in the scheme that counteract its goals, and a lack of long-term certainty around its future and the wider involvement of further countries:

Allocation processes. An emissions trading scheme will only work if buyers and sellers exist, driven by an overall need to cut back emissions — scarcity creates a market price. Each member state can define allocation plans that distribute allowances to industrial sites and even set their overall cap. This, together with the approach used to date to base allocations on sectors' projected emissions, has made setting targets that generate tangible cut-backs problematic and created inconsistencies between countries. Concerns about unfair treatment between different member states can then be used to undermine the prospects for stronger emission caps

Perverse incentives. Some features of the scheme undermine its practical impact on emissions. Under the current UK rules, a new site will be given allowances to cover its needs, whether it be efficient or not — removing the incentive to open cutting-edge efficient plant. Allowances will be withdrawn from a site that closes, reducing the incentive to shut down old emitting plant. Moreover, if companies believe that their share of future allocations may be based on their emissions over the first phase ('updating'), there is a perverse value to increasing emissions at present, particularly if caps are to be tighter and the market price higher in the second phase, which also lasts longer. Since the basis of entry, exit and updating rules can currently vary in each member state, this is another example of the need for greater harmonisation of approaches across Europe

Long-term certainty and coverage. Firms require regulatory certainty to make long-term investments. Standing in 2005, the first two phases of the EU ETS will take us to 2012, or seven years. Many investments made will rely on cash flows lasting significantly longer than seven years. There is thus a need to define the future of the EU ETS post 2012 (Phase 3), or to find other means of providing some security about carbon-related incentives post 2012, at a time when there is uncertainty about the wider international processes on post-2012 commitments.

Robust implementation of the EU ETS is not something the UK can achieve in isolation, it will only be achieved if agreement can be reached across Europe on more common approaches to allocation. Just as with the wider political process of engaging countries outside the EU on these issues, the UK needs to take a leadership role, both in its own actions and in using its position to help guide change.

One underlying problem shared between the EU ETS and the CCA scheme is the complexity of allocation/target negotiations, and particularly the asymmetries involved. Whilst the processes have pushed companies to understand their abatement opportunities in more detail, they inevitably have far more information than Government coming into such negotiations, which makes it hard for the Government to negotiate appropriate cut-backs. One important reason for preferring emissions trading as a principal instrument going forward is that the subsequent market performance will, over time, start to reveal the real cost of abatement.

Chart 31 *Core features of proposed UK Consumption-based Emissions Trading Scheme (UK CETS)*

New UK Consumption-based Emissions Trading Scheme (CETS) could target rapidly rising power consumption in large non-energy intensive (LNEI) companies and public sector organisations

	Core features	Rationale	Possible extension
Operation and incentive	Companies must obtain allowances to cover emissions, in return for a CCL discount	The need to acquire verified allowances addresses the behaviour and motivation barrier far more effectively than individual sites paying a marginal electricity tax	Self-selection (opt-in) to escape rising CCL
Target sectors	Large non-energy-intensive companies and public sector Industrial SMEs with half-hourly meters*	Exploits the capacity of large firms to manage their energy Addresses numerous small sites with minimal difficulty Sector is experiencing rapid emissions growth, addressed only by the CCL	Some CCA sectors
Emissions coverage	Covers *direct* and *electricity-embodied* emissions	Electricity accounts for 70% of LNEI sector emissions Enables rational trade-off with decentralised/local/ cogeneration	Transport emissions (e.g. haulage)
Allocation	Most allowances to be bought from auction or from EU ETS	Sectors are not energy-intensive so competitiveness is not a concern Greatly simplifies the allocation process – no company-specific projections etc	EU ETS link may improve price and stability in EU ETS

Note: *Half-hourly (HH) metering as potential requirement for entry represents c.14k organisations with >90TWhrs of electricity consumption. Holders of HH meters have electricity consumption >100kW three times per month, equating to an energy bill of >£13k p.a.
Source: The Carbon Trust.

UK Consumption-based Emissions Trading Scheme (UK CETS)

Section 2.4 introduced a proposal to address rising emissions from large companies in the less energy-intensive sectors using a UK Consumption-based Emissions Trading Scheme (UK CETS). The core rationale for this scheme is that the need to acquire, at company level, allowances and verify this against corporate energy use will address several barriers far more effectively and efficiently than having numerous sites around the country just paying their energy bills, by getting the issue of energy management into the managerial structures of large, efficient companies.

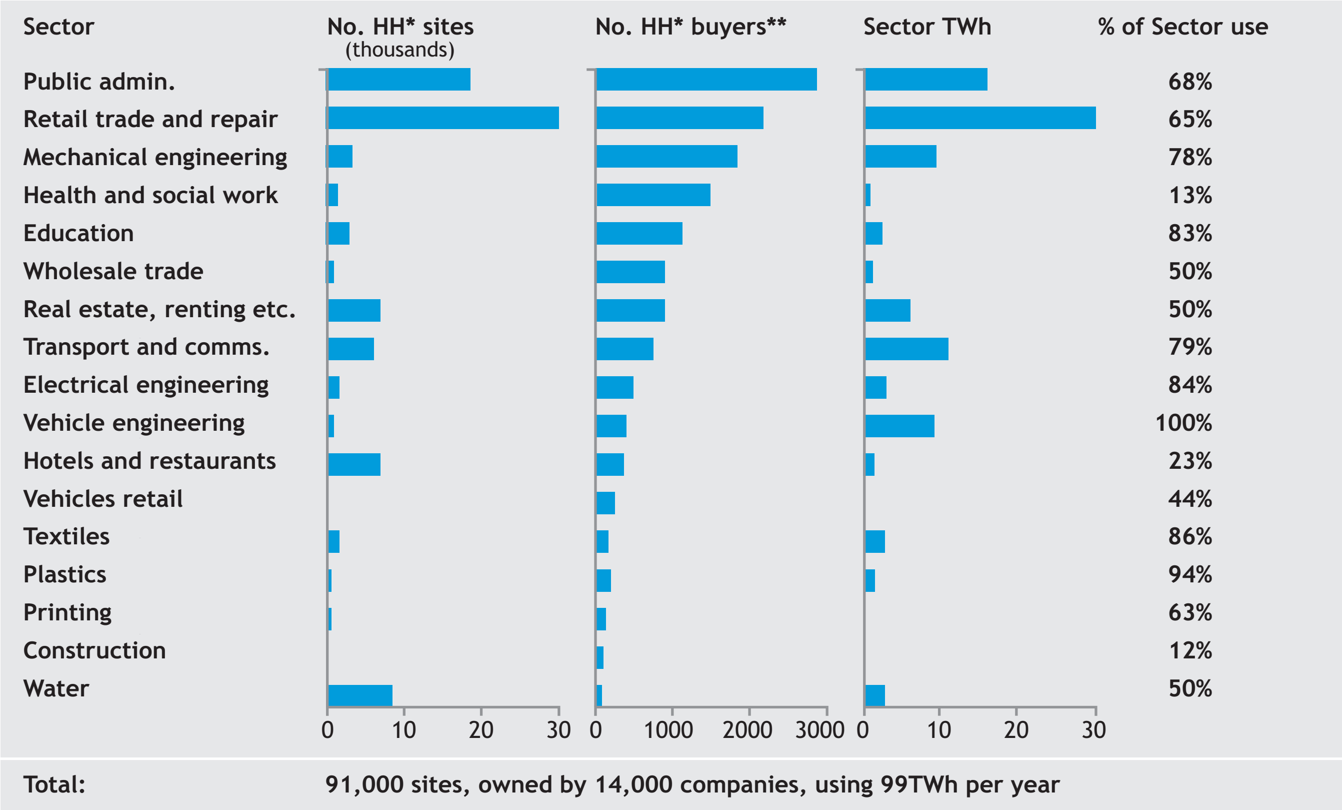
Chart 31 summarises the core features of the proposed UK CETS. In its broad design, it is intended to deliver as efficiently as possible emission savings from large organisations that are outside the scope of the EU ETS or CCA agreements – about 13,000 organisations outside of the public sector, using the definitions underlying our general classification (Chart 3).

Section 2.4 sketched some of the general design issues and options. For these large companies, the broad issues of implementation in terms of reporting and compliance, in terms of the legal processes, can be most simply addressed through the existing processes of corporate accounts auditing. The bigger issue in implementation is likely to be the exact definition of coverage and consequent monitoring of emissions. Given the problems of metering noted earlier, this is potentially a thorny issue.

The most secure way of addressing monitoring, in respect of electricity-related emissions, would be to include only operations that are covered by half-hourly meters, which give a far greater precision and reliability of monitoring than standard meters. Currently, these meters are required for sites with a peak load of electricity consumption exceeding 100kW – approximately equivalent to a minimum electricity

***Chart 32** Present sectoral and emissions coverage of half-hourly meters*

Potential coverage of UK CETS based on half-hourly electricity metering



Note: *Half-hourly meters; **Implies overall average of 7 sites per buyer.
Source: Datamonitor.

bill of ~£10-20k. Chart 32 shows their coverage by sector across the less energy-intensive segments of the business and public sectors (where the bulk of emissions are not covered by CCA or EU ETS). Using half-hourly metering as an entry criteria, the emissions coverage of the UK CETS (as modelled in our bottom-up analysis) would cover about 20MtC, split roughly equally between manufacturing and service sectors.

It is also notable that excluding public administration, the data indicate that five sectors (retail trade and repair; mechanical engineering; real estate etc.; transport and communications; and vehicle engineering) dominate the total TWh demand and that half-hourly metering already accounts for at least 50% of the energy in these sectors, and 80% or more in three of the five. Half-hourly metering in general, or possibly applied on a sector basis, may therefore provide a ready entry route to defining coverage. The UK CETS scheme would of course encompass direct fossil fuel use, as well as electricity, which will require similarly credible monitoring.

More generally, however, the issues of monitoring and metering emissions in such less energy-intensive sectors are ones that need to be addressed irrespective of the specific policy instruments used to drive change. Our study has presented overwhelming evidence of the scale of cost-effective abatement opportunities from such sectors. This reflects the fact that energy consumption in these sectors has generally just not been managed; and they will never manage properly what is not measured properly. Good metering is not a cost to be attributed to any particular instrument, but a general prerequisite for an energy-efficient economy in an era of rising energy prices and carbon constraints. Technological advance has made advanced metering far cheaper and more accessible and there remains significant scope to extend its use.

Energy Efficiency Commitment (EEC) for SMEs

To address the thornier problem of emissions from small and medium-sized enterprises (SMEs), the possible new EEC for SMEs scheme described in Section 2.4 would place an obligation upon energy suppliers to implement energy-saving measures in the SME market. This could be implemented as a separate scheme, or the existing scheme targeting the domestic sector could be extended to cover SMEs. If the existing scheme were extended it would be important to de-couple any fuel poverty targets from the SME targets.

One concern with extending the existing scheme would be whether the suppliers would focus on abatement measures with larger SMEs at the expense of delivering measures in the domestic sector, to lower delivery costs. Whilst this is possible, including buildings-related emissions from SMEs (~6MtC) in the domestic EEC (covers ~40MtC domestic emissions) would only increase the total emissions covered by around 15%, so suppliers would not be able to deliver all their required change from SMEs alone. It is also arguable that local authorities act as cost-effective aggregators of domestic EEC opportunities available to suppliers, and that no such effective parallel exists for SMEs.

In the current domestic EEC the suppliers meet their obligation primarily by installing loft and cavity wall insulation measures (56% of the 2002-2005 target of 62TWh). Distribution of compact fluorescent lamps (CFLs), promotion of fuel switching including subsidy of ground source heat pumps, installation of A or B-rated boilers and subsidy of A-rated cold and wet appliances also contributed. Suppliers have been able to pass these costs on to energy prices, so the consumer effectively pays the full cost of the equipment installed plus the administrative costs borne by the supplier. The latest estimate is that the current EEC costs residential customers around ~£9 per fuel per year (i.e. ~£18 total cost per customer for electricity and gas). The cost of extending the EEC to SMEs could essentially be funded in the same way, by direct pass-through to electricity prices in the targeted markets. This would also create a spectrum of winners and losers though in the case of SMEs there would be a greater variance around the average than is the case for domestic consumers.

There are two key concerns with the EEC approach as applied to SMEs. Firstly, as with the project certificate scheme described in Section 2.4, this measures-based scheme does involve significant administrative costs associated with assigning estimated savings to measures and the verification of actions put in place. Moreover, as the EEC scheme makes no attempt to measure actual carbon savings achieved, there are potential concerns over the level and persistence of savings.

The Government is investigating several ways of improving the domestic EEC, to improve the flexibility for suppliers by allowing more explicit trading of certificates and making it easier for third parties (e.g. energy services companies) to deliver and sell certificates. These are outside the scope of this work, but there appears no reason why SMEs couldn't be included in the next generation of this scheme, particularly if measures are taken to ensure delivery is spread equitably across the targeted segments (e.g. smaller companies with domestic-like characteristics could be included in the first instance). Nevertheless, as indicated, the carbon delivery is likely to be modest (~0.2MtC p.a. in 2020).

Other instruments: interest-free loan scheme for SMEs; product standards; public sector instruments

Interest-free loans for SMEs overcome financial barriers amongst SMEs but need to be simple and easy to obtain if small companies are to use them. The pilot scheme run by the Carbon Trust has shown that one effective route to market is through the suppliers of equipment. The link to a Carbon Trust scheme acts as a 'seal of approval' for suppliers, which, combined with the access to capital created by the interest-free loan, benefits qualifying equipment manufacturers. By pre-qualifying the technology and providing carbon-saving estimates, the equipment supplier can also take some of the administrative burden away from customers. This is only part of the solution, as SMEs will need to be given impartial advice and support in the choice of projects to take up and on how to implement them (the Carbon Trust is one source of this). To reach the suggested fund scale of ~£150m by 2020, one alternative to using solely public funding would be to use Government funds to leverage in private sector investment.

Section 2.3 also explained the role of product standards and labelling as another route to increase the penetration of energy-efficient equipment, either by removing inefficient equipment from the market or informing buying decisions through transparent performance labelling. They can be implemented in a number of forms: pure labelling; labelling linked to financial incentives (such as the current ECA scheme); or as mandatory standards. Mandatory standards for specific products cannot be implemented in the UK in isolation. A recent EU Framework Directive, the Energy Using Products Directive, requires product standards to be set EU-wide in order to encourage a common internal European market. It allows fast-track development of 'daughter' directives for specific product standards. The EU Commission is currently developing preparatory studies to develop a list of priority products; the earliest expectation is that new standards could be developed over a period of 18 months to two years.

Our analysis indicates that in the UK, product standards for simple selected heating and lighting equipment could save up to 0.7MtC p.a. in 2020. However, since the UK is unable to act in isolation, it should engage with the EU Commission to ensure that the opportunity created by product standards is taken.

Labelling schemes, particularly those linked to a financial incentive such as an ECA, could enable the UK to deliver a similar effect more flexibly and with greater speed by acting alone. It enables a wider range of technologies to be incorporated and more control of the performance requirements for eligibility — that can be ramped up to increase the impact of the scheme. As with the interest-free loan scheme for SMEs, the administrative burden of applying for any financial incentive needs to be minimised for it to have maximum effect. Whilst not as forceful as introducing mandatory standards, our analysis indicates that a labelling scheme linked to ECAs could save ~0.3MtC p.a. in 2020.

Finally, the public sector has pledged that it will take a leadership position in reducing carbon emissions, setting aggressive delivery targets. As explained in Section 2.4, more focused action will be required to deliver these goals. There is currently no agreed baseline or mapping of public sector emissions, without which targets become meaningless. The current targets need to be made real and rolled out with clear accountability. Moreover, resource needs to be built up through improved internal capability, and financial barriers overcome. The interest-free loan scheme proposed for the public sector, likewise needs to be simple and easy to use if it is to be a success. The public sector also needs to leverage its significant purchasing power. The goal to buy/rent only top quartile buildings needs to be made actionable by measuring the performance of buildings and providing guidance and support to buyers, particularly through the PFI route where the whole life cycle carbon footprint of the installation can be impacted.

About the Carbon Trust

The Carbon Trust is an independent company whose funding primarily comes from Government. Its role is to help the UK move to a low carbon economy by helping the business and public sectors reduce carbon emissions now and capture the commercial opportunities of low carbon technologies. In practice this is achieved via the three-pronged approach of providing the business and the public sectors with support to reduce their carbon emissions, investing in and developing new low carbon technologies and increasing understanding of climate change through awareness-raising campaigns and leading-edge market studies.

Help to businesses to reduce their carbon emissions comes through a range of offerings, from general advice provided through a helpline, website and publications, to personalised business advice in the form of on-site energy surveys, design advice for new buildings and refurbishments and company-specific consultancy on carbon management and energy efficiency for large energy users (i.e. help companies to understand the business risks and opportunities around the transition to a low carbon economy).

The Carbon Trust also drives the development of new low carbon technologies through R&D funding, incubator support for early stage companies, direct venture capital investment and technology acceleration projects which help overcome barriers and demonstrate the potential of emerging low carbon sectors, since innovation will be essential to meet the long-term goal of reaching a low carbon economy.

The Carbon Trust's data and experiences have helped to inform the analysis presented in this report. That experience indicates firmly that UK business and the public sector can reduce their carbon emissions, and can do so cost-effectively, but there is no 'magic bullet'. Achieving cost-effective reductions will require an appropriate mix of regulatory, information and standard-setting policies targeted to address particular barriers to action; price-based policies increase awareness that enhances the value of low-carbon options; and support measures that help companies to identify and deliver the specific actions that they can take to respond to these incentives. Only such a combination of measures, working together in targeted and strengthened ways, will successfully move the UK towards a low carbon economy.

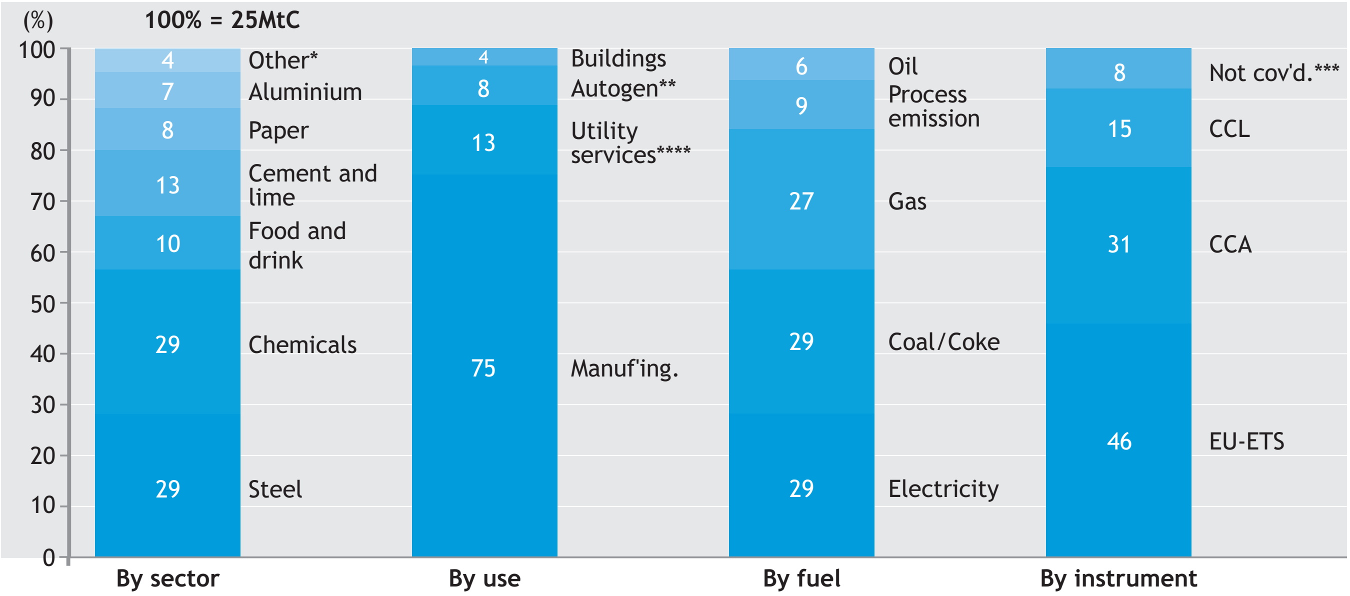
Further information

This study has drawn on a wide variety of sources for its analysis, including internal data from Carbon Trust programmes and surveys, Government reports, academic literature, and the work of the Consultants to this study. Supporting material will be available from the Carbon Trust website, www.thecarbontrust.co.uk

Appendices

More detailed breakdown of emissions by segment in the business and public sectors:

Breakdown of large (>50 emps) energy intensive industry emissions 2002, %

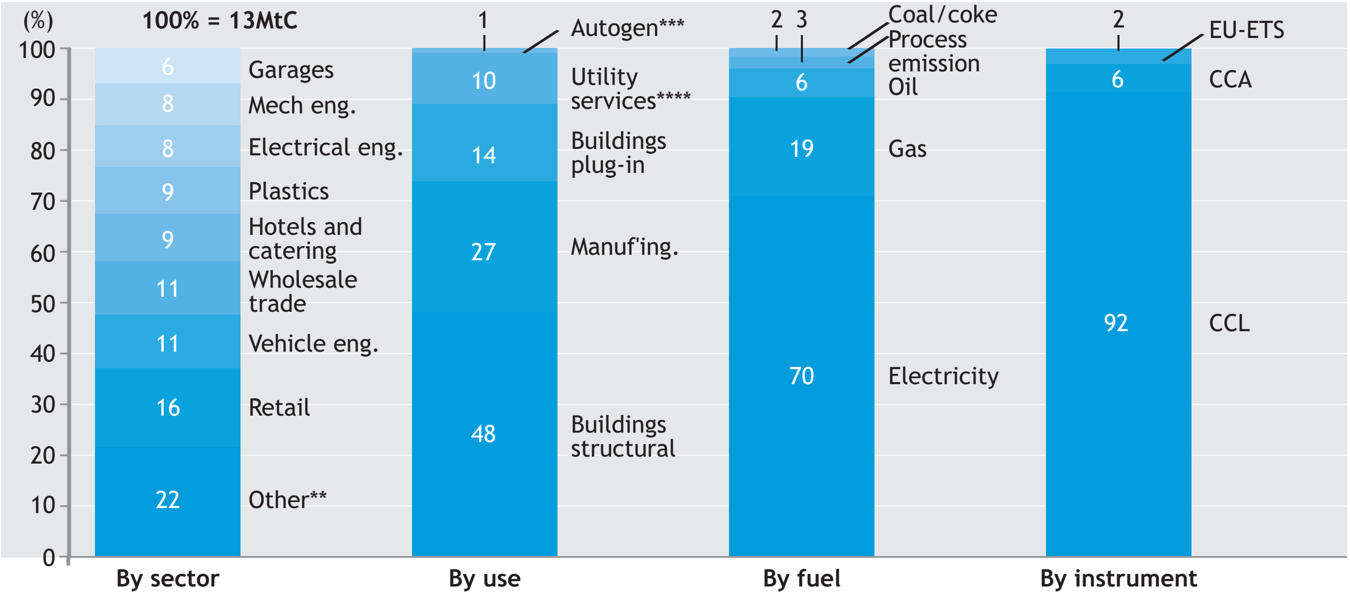


Key characteristics

- Steel and Chemicals generate >50% of emissions
- Manufacturing dominates energy intensive industrial emissions
- The fuel mix is split quite evenly between electricity, coal/coke and gas
- EU ETS and CCA are the key regulatory instrument for this entity type.

Note: *Other includes Bricks, Ceramics, Glass and Other Non-Ferrous Metals; **Autogeneration emissions associated with self-generation; ***Not Cov'd. – e.g. process emissions not covered by existing instruments; ****Manufacturing emissions due to equipment used to support main process: including motors and drives, refrigeration and compressed air drives.
Source: Ecofys.

Breakdown of large* non-energy intensive organisations emissions 2002, %

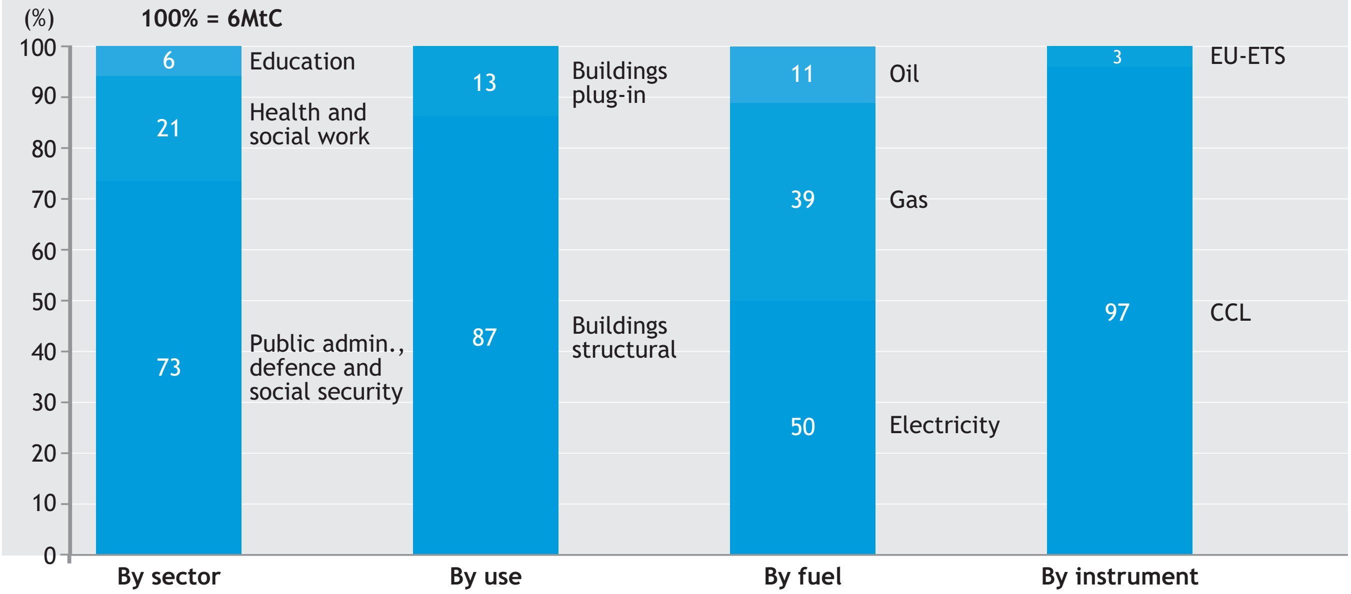


Key characteristics

- Emissions are spread relatively evenly across sectors
- Buildings usage accounts for over 60% of emissions
- The fuel mix is dominated by electricity
- CCL is the key regulatory instrument for this entity type.

Note: *Over 50 employees in industry and 250 employees in service sector; **Other includes Transport and Storage, Real Estate, Construction, Non-Metallic Minerals, Printing, Textiles, Water and Other Industries; ***Autogeneration emissions associated with self-generation; ****Manufacturing emissions due to equipment used to support main process: including motors and drives, refrigeration and compressed air drives.
Source: Ecofys.

Breakdown of public sector emissions 2002, %

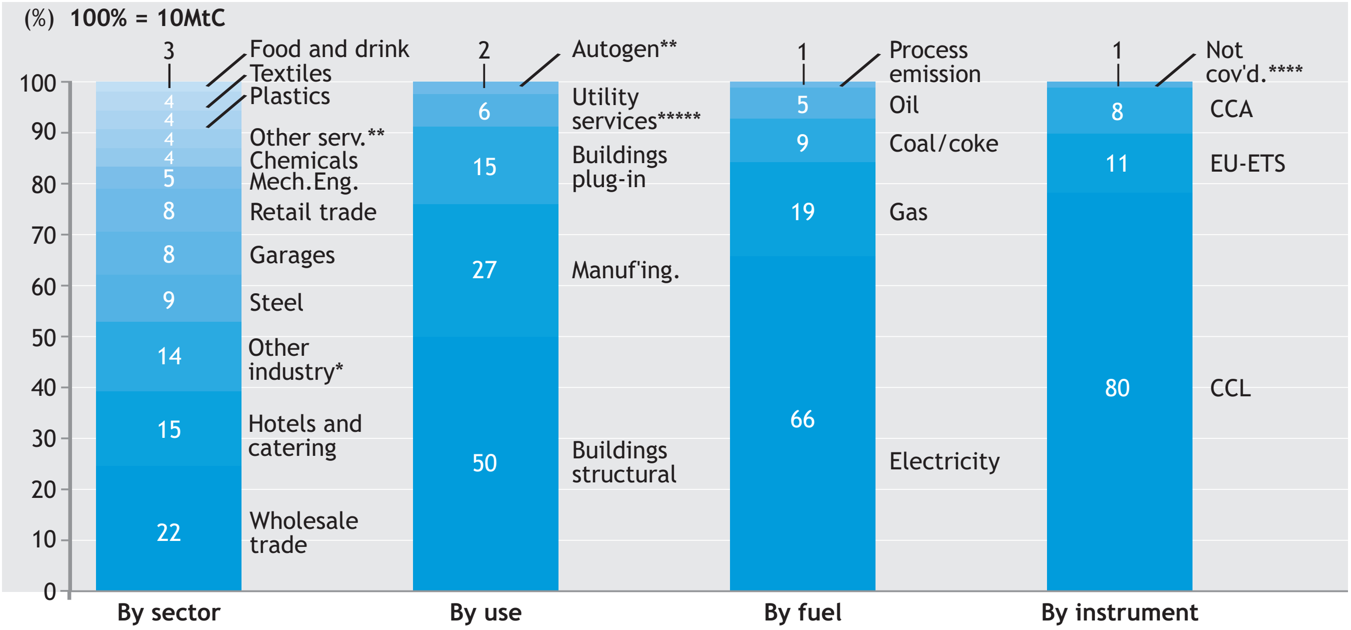


Key characteristics

- Public sector emissions are exclusively buildings-related
- Electricity and gas make up 90% of the fuel mix
- CCL is the key regulatory instrument for this entity type.

Source: Ecofys.

Breakdown of industrial (<50 emps) and service (<250 emps) SME emissions 2002, %



Key characteristics

- SME emissions are highly fragmented by sector
- Buildings make up ~2/3rds of SME emissions
- Electricity makes up 2/3rds of the SME fuel mix
- Although CCL is the key regulatory instrument for SMEs, 11% of SMEs are covered by EU ETS.

Note: *Other Industry includes Bricks, Cement, Ceramics, Glass, Aluminium, Other Non-Ferrous Metals, Construction, Vehicle Engineering, Water, Non-Metallic Minerals, Printing, Paper, Electrical Engineering and Other Industries; ** Other Serv includes Transport and Storage and Real Estate; ***Autogeneration emissions associated with self-generation; ****Not Cov'd. – Process emissions not covered by existing instruments; *****Manufacturing emissions due to equipment used to support main process: including motors and drives, refrigeration and compressed air drives.
Source: Ecofys.

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Making business sense of climate change

The Carbon Trust works with business and the public sector to cut carbon emissions and capture the commercial potential of low carbon technologies.

An independent company set up by the Government to help the UK meet its climate change obligations through business-focused solutions to carbon emission reduction, the Carbon Trust is grant funded by the Department for Environment, Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and Invest Northern Ireland.

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