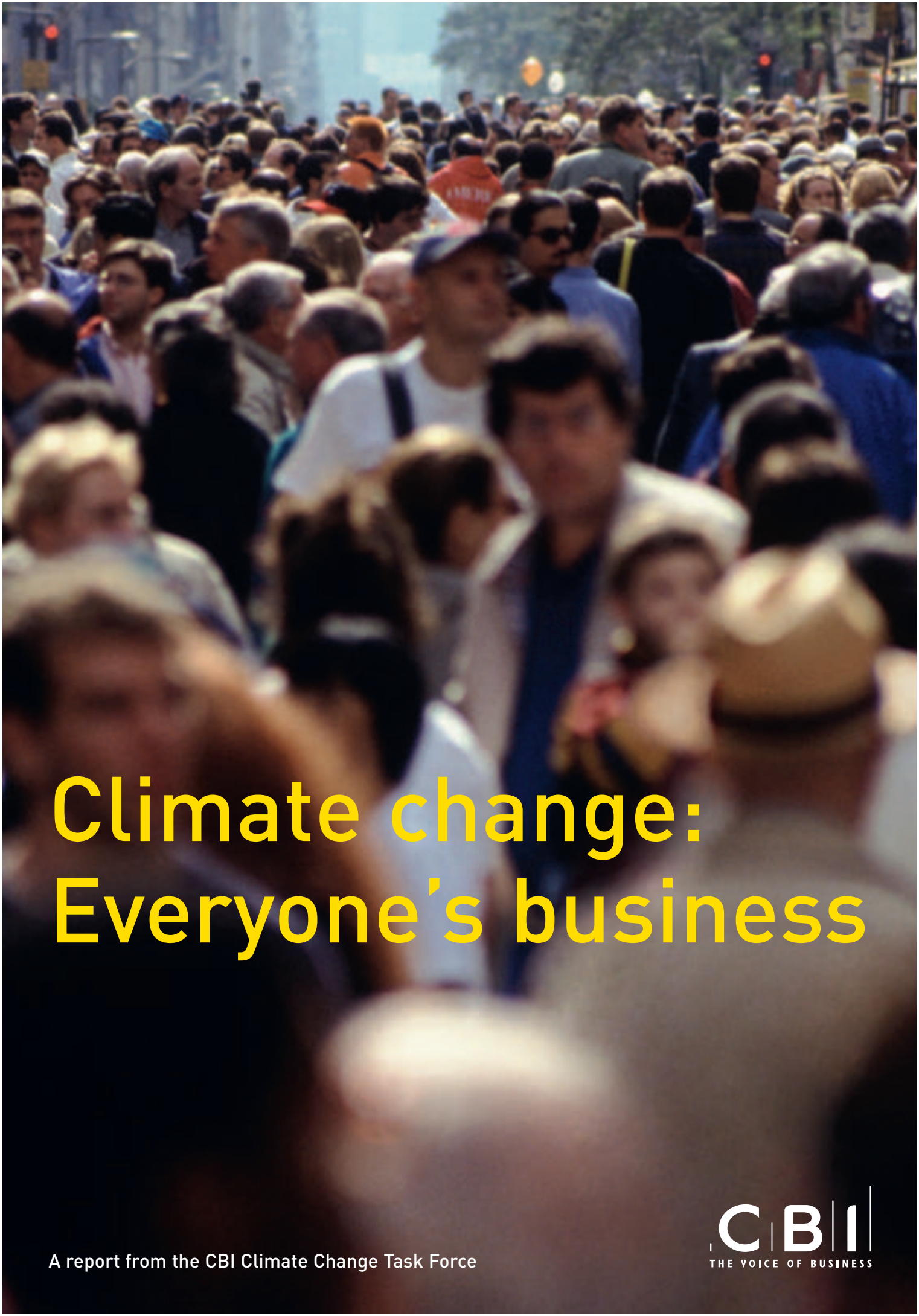

Climate change: Everyone's business

A report from the CBI Climate Change Task Force

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Foreword

This report has not been written by evangelists but by business people.

Are we sure that climate change exists? I am sorry, but that is not a question for us. The best question for the business community is whether we can be certain that climate change presents a substantial risk; a risk that will have a profound impact on society and the economy? To this the answer is clearly "yes". And so, as with all substantial risks, it is vital to mitigate the danger.

This report contains the independent conclusions and responses of some of the leading companies headquartered in the UK and represented by their CEO or Chairman. It makes far-reaching commitments and recommendations after a journey of intensive discussions and study. Not easy, not always unanimous, but ultimately underwritten by all. We submit this to the CBI, and to the wider public in the belief that it can be a catalyst for change.

Any response to the threat of climate change requires three components for success. Politicians must give much greater priority to the subject, and not just on an ad hoc basis. Consumers have to be empowered to make the right decisions and need to be given the facts to make informed judgements. And business must become green to grow.

Of course climate change is a global challenge. But in the UK we should not wait for others. The issue at hand is serious and requires an immediate response. Action taken sooner is both better and cheaper. And it is clear that alongside the challenge lies an opportunity. One we can harvest by acting now and in concert to build a low carbon economy.

Ben Verwaayen, Chairman, Climate Change Task Force and Chief Executive, BT

A much greater sense of urgency is required if the UK is to meet its targets for reducing greenhouse gas emissions

Report summary

The next two or three years will be critical. A much greater sense of urgency is required if the UK is to meet its targets for reducing greenhouse gas emissions at an affordable cost, and to establish an international leadership role in the low carbon economy of the future.

Already it is clear that the government's targets for cutting greenhouse gases by 2020 are unlikely to be met solely through measures taken in the UK. Its longer-term goals for 2050 are also very challenging, and will not be achieved without significant additional effort.

Failure to act now will mean that the costs of tackling climate change in the future will be much higher. The UK will also miss out on the commercial opportunities that will emerge on the pathway to a low carbon economy.

The CBI's Climate Change Task Force has spent 10 months analysing this challenge. It is made up of business leaders from key sectors of the UK economy and whose companies globally employ nearly 2 million people, generating annual revenues of approximately £1000bn.

Informed by a major study commissioned from McKinsey, the Task Force has assessed the economic benefits and costs of different options for reducing greenhouse gas emissions. We have focused on what needs to be done by 2030 to be on track for the government's 2050 target.

And its conclusion is that substantial changes will be needed in the way the economy works if the UK is to meet its goals. Many of the technologies and solutions that will be required already exist but are not yet commercially viable. The pace and scale of implementation must now be accelerated.

The report shows that by 2030, moving to low carbon sources of electricity and improving energy use in buildings can each deliver about 30 per cent of the additional cuts needed, with the remaining 40 per cent coming from transport and industry. For the longer term to 2050, further change is needed to more than double the level of energy efficiency and halve the carbon content of the energy used in the economy compared with today.

But most taxes and regulations were designed for the old economy. The report calls for a shift to a world where carbon becomes a new currency – so that consumers and businesses are rewarded for making the right choices. Carbon has to be priced according to supply and demand, under a system which leads to lower emissions, crosses national borders, and rewards good behaviour.

According to the McKinsey analysis, additional action needed in the UK to meet the government's targets implies a maximum price of €40 per tonne of CO_2 equivalent (tCO_2e) by 2030 provided that the full range and scale of initiatives are implemented. The maximum price would be higher in 2020 (€60-€90 per tCO_2e and possibly more) given the higher cost of emerging technologies in the short term.

This translates into an investment of around £100 a year per household (under 1 per cent of GDP) by 2030. This investment will help pay for a more sustainable way of life and shift resources to those parts of the economy providing low carbon products and services. Some households would pay less than this, depending on things such as their current use of energy and how successfully they take up cost-effective measures to improve energy efficiency.

Changes on the scale needed and at affordable cost will only happen if government, business and consumers work together. Government cannot do the job by itself, nor can business: but together we can use our position as one of the world's great trading nations to secure global action.

If we are to succeed, the climate change agenda must therefore become everybody's business. Our commitment is to help achieve that and work with others to implement the necessary actions at home and abroad.

The report sends out five clear messages:

- The government's targets for 2050 are stretching but achievable and at a manageable cost – provided early action is taken. The three interdependent players are consumers, who drive change; government, which sets the framework and works with other countries to build international agreements for reducing emissions; and business, which invests and delivers.

- In the run up to 2020, the emphasis must be on much higher energy efficiency together with preparations for a major shift to low carbon energy sources in the years to 2030 and beyond. The big opportunity here is that a third of our generating capacity will become obsolete over the next 25 years, and must be replaced. This opens the way to a smaller carbon footprint.

- Technology has a vital part to play in opening up sustainable solutions. The UK has a unique opportunity to prosper in key markets of the future by taking a lead in the development of low carbon technologies and services in power, buildings, transport and industry. Government must give higher priority to existing research and technology programmes in these areas, and support the launch of new programmes to develop emerging solutions.

- Empowering consumers to make low carbon choices is equally vital. Business and government must work together not only to encourage take-up of greener products, but also to promote new ways of doing things (such as smarter ways of working) which can help improve our quality of life as well as cutting emissions.

- Market forces will drive big changes, but they will not by themselves be enough to do the job. The full range of public policies must be deployed to create the right incentives. Priorities include promoting an effective market price for carbon; revenue-neutral tax reform (such as changes to business rates and council tax) to reward greener behaviour; and bigger, more focused research and development (R&D) programmes to finance new technologies and solutions until they become commercial.

Implementation is now the key. The pace of change in all areas of carbon reduction must be far higher than it is today. For example, the current rate of insulating the existing housing stock needs to triple over the next 20 years. This will only be achieved through much closer working between government, business and consumers, with the focus on delivery.

In some cases, the priority is to improve the existing wide range of public policies, for example, by building on welcome initiatives such as the EU Emissions Trading Scheme (EU ETS) or delivering on plans to improve the planning system. In other cases, business needs to take a lead, for example, in agreeing new standards for measuring corporate and product-related emissions, to help drive continuous improvement. In all cases, key decisions must be taken in the next three years if the UK is to get on track to meet its emissions targets (see figure 1, page 4).

Trust between consumers, business and government is another critical ingredient for success. There would be no quicker way of destroying confidence in the climate change agenda than by using green excuses to bolster tax revenues. Consumers also need confidence in the information they are given about the environmental impact of different products and services.

Economic competitiveness must underpin climate change policy. This means giving priority to energy efficiency measures, which must deliver a substantial part of the needed cut in emissions. Sectors like steel or chemicals, which face intense competition from countries that are not yet seeking to cut their emissions, will also need special consideration.

So what's to be done?

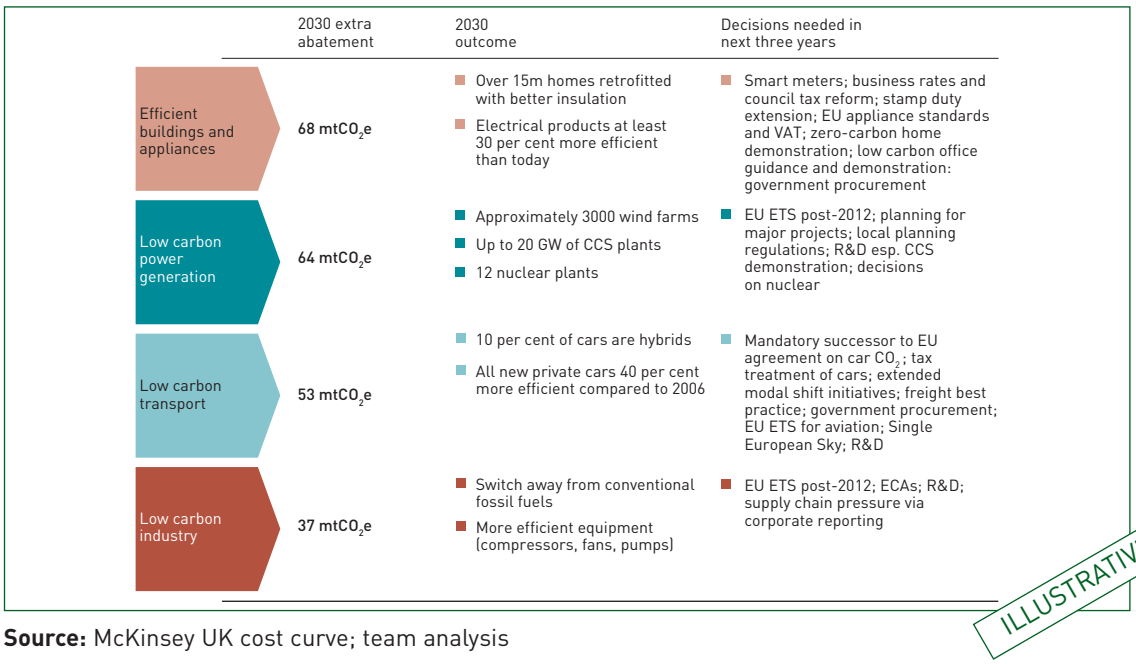
Consumers are the essential driver for change. Combining the emissions for which they are directly responsible with those that they influence through their purchasing decisions, they have an impact on some 60 per cent of UK emissions. As voters, they have a powerful influence on public policy. They need the information, the incentives, and the opportunity to make low carbon choices. They will require:

- Reliable and consistent information about the consequences of their choices.

- Much wider access to low carbon products and services than is on offer today.

- Incentives to make low carbon investments. For example, consumers could already be making worthwhile cost savings through improved insulation of their homes – but they do not, because for them the payback period is too long. Government and business must look for creative ways to bridge this timing gap.

Figure 1: Timelines to implement policies are tough and decisions need to be made in the next three years



Source: McKinsey UK cost curve; team analysis

The UK government has done more than most others to set a framework for change. We welcome the proposals in the Climate Change Bill as important elements of a framework to promote significant cuts in emissions. But it must now focus on implementation as a matter of urgency. It must go with the grain of the market wherever possible, by removing barriers to change. This means it must:

- In the coming 12 months, pass the legislation needed to rebuild the UK's power generation capacity in a timely manner, with a diverse, low carbon energy mix. All options will have to be available, including renewable energy and nuclear. Early reform of the planning system is essential.
- Push for agreement early next year on the post-2012 design of the EU ETS, which will be vital in establishing an effective long-term carbon price.
- Prioritise investment in relevant research and technology. That means re-allocating existing resources, and adding new funds where necessary. The aim should be at least to match the EU average for investing in energy and climate change technology.
- Empower consumers through education, communications and incentives.
- Provide incentives, regulation and tax structures which stimulate a low carbon economy, and ensure consistently supportive policies.
- Take a leadership role in international negotiations for climate change agreements.

Business has already made significant progress in responding to the climate change agenda. It is well placed to make an early and decisive contribution to finding and implementing solutions to the challenge of climate change. Its priorities now must be to:

- Incorporate climate change policies into its DNA. Consumer demand will stimulate competition to produce greener alternatives to current products and services, and reward those businesses that take a lead. In the low carbon future, companies will have to be green to grow.
- Redouble efforts to improve energy efficiency, by focusing on areas such as transport and buildings.
- Work with employees and the supply chain to reduce emissions, and adapt the current workplace to cope with the climatic and other changes that are already likely as a result of past CO_2 emissions.
- Measure its carbon footprint, and develop reporting systems to benchmark performance.
- Provide consumers with the reliable communications and product developments they will require.

Members of the Task Force are committed to meeting the challenge. With a global carbon footprint from their operations of close to 370 $mtCO_2e$, or roughly 1 per cent of global emissions, they readily accept their responsibility to take positive action.

Companies represented on the Task Force have already taken significant action to tackle emissions. Equally, they recognise that more must be done. **Their first priority therefore is to ensure they deliver their existing corporate commitments to further emissions reduction** (see box 12, page 40).

In addition, they are now pledging to:

Develop new products and services that will enable all households in the UK to cut their emissions in half by 2020. Task Force companies provide a wide range of products and services to millions of customers. We will work with others to draw up an action plan and milestones which will build on existing initiatives to reduce emissions in homes, appliances and personal travel. One initiative, led by Barclays, will develop green finance products: other products will follow.

Work with our 2m employees to help them reduce their greenhouse gas emissions at work and at home. Our aim is to begin by identifying and promoting action to save 1 $mtCO_2e$ within three years. We will coordinate this work with our efforts to help all households cut their emissions.

Promote effective reporting procedures that set the benchmark for reporting carbon emissions.* We will work with others, including the Carbon Trust, to promote a standard that could be adopted by all companies above a certain size, and we will develop a small and medium enterprise (SME) friendly version.

Work with government to co-ordinate and manage the implementation of emission saving projects and to improve the effectiveness of spending on R&D of new technologies. Our goal is to create the framework through which government and business can collaborate together to build a low carbon economy.

Audit and cut emissions from company car fleets and buildings. Our ambition is to do better than the government's own targets as set out in its Sustainable Procurement Action Plan.

Provide resources over three years to strengthen the CBI's work on climate change in the UK and internationally, and oversee the deployment of this resource.

This report is therefore a call to action. For companies on the Task Force, it marks the latest stage of a journey which builds on their existing commitments to tackle climate change. For the CBI, it marks the start of greater engagement on this agenda with all its members as well as the international business community and other stakeholders. Together with government and consumers, our goal is to work towards a greener and more prosperous planet.

* This specific commitment excludes the London Stock Exchange in relation to the companies on its markets.

Box 1: Key climate change concepts

The main focus of this report is the reduction of greenhouse gases in the atmosphere (**mitigation** of climate change) which at its simplest can be achieved by reducing the carbon emitted from use of energy and improving energy efficiency. The report analyses which technologies can save carbon (**abatement** measures) and what financial incentive (**price of carbon**) is required to encourage take-up of these technologies. In some cases, such as home insulation, the technologies will not have any overall cost to society, but for others, such as wind power, there will be an additional cost (or **marginal cost of carbon**) for using carbon-saving technologies over more traditional technologies such as fossil fuel-fired power stations.

To a lesser extent the report also deals with reducing the inevitable impacts of a changing climate (**adaptation**) such as building flood defence barriers or locating infrastructure away from vulnerable areas like flood plains or coastal low-lands, and in particular, the need for a better understanding of what effect these impacts might have on business.

Throughout the report the carbon saved is measured in tonnes of carbon dioxide equivalent, or **tCO_2e** – an internationally accepted measure that expresses the amount of global warming of greenhouse gases in the equivalent amount of carbon dioxide, CO_2. Where the amount saved is over a million tonnes we have used **$mtCO_2e$**.


EVENING NEWS
The challenge of climate change
EVENING NEWS

Emissions need to peak and fall in the next 10 to 20 years

Climate change needs an urgent response

The earth is warming and scientists are increasingly confident that this is due to the rise in man-made greenhouse gas emissions caused by industrialisation.

Higher temperatures are leading to widespread melting of snow and ice, and rising sea levels. Their effects can be felt in a changing global climate, whether as increased rainfall and more frequent storms in some parts of the world, or more intense and longer droughts in others.

Continued emissions at or above current rates will cause more warming and bigger climate changes in the years ahead. The impact on fresh water access, food production and health will vary across the globe, but is likely to be destructive and to grow over time.

Recent reports by the Intergovernmental Panel on Climate Change (IPCC) and the Stern Review point to serious risks to the global economy and human society if no action is taken. All this presents hard choices for governments, businesses and people across the world.

Some further climate change is inevitable as a result of emissions that are already in the atmosphere. A balance has to be struck between the measures required to adapt our economy to allow for this, and the action needed to prevent further, more extreme climate change. The faster and deeper we try to cut emissions, the higher the likely short-term costs. But the more we delay such action, the greater chance of even bigger costs in the long run.

These choices need to be managed carefully, but there is a growing international scientific consensus in favour of urgent action. Out of the past 12 years, 11 have been among the warmest since 1850, and the rise in average sea levels seems to have accelerated. The cuts in global emissions needed to limit climate change to acceptable levels could be greater than previously thought – which would mean that emissions need to peak and fall in the next 10 to 20 years rather than rising as they would on present trends.

We have a unique opportunity to show how tackling climate change can go together with a healthy economy and improved quality of life

The role of the UK in global efforts

International partnership is essential in stepping up to the challenge of climate change. The developed world currently accounts for most greenhouse gas emissions, but emissions from economies such as China and India are growing fast and will soon overtake those from the USA and Western Europe. The IPCC and others have identified substantial potential to cut emissions around the world, through action in areas such as power generation and transport, as well as in agriculture and re-forestation.

Some 2 per cent of global emissions occur in the UK, mainly from the carbon dioxide released by using fossil fuels to meet our need for energy in the home, in business and for transport (see figure 2). The direct contribution we can make to tackle climate change thus appears to be limited.

Yet the carbon footprint of our economy is larger than that. After taking into account the carbon emitted to produce the imports we buy, as well as the goods and services we export, it increases by at least 10 per cent. The overseas activities of UK firms, banks and pension funds also add to the size of our footprint. The direct global emissions from the UK's 100 largest firms alone are estimated to be equivalent to over 1.5 per cent of the global total.

UK scientists and economists, together with the Stern Review, have helped to shape the international debate about climate change. Major UK companies are taking a lead in working to reduce the emissions from their supply chain, and in offering low carbon products and services to their customers worldwide.

The UK can further extend its influence as a leading member of the European Union. The EU is responsible for 14 per cent of global emissions and has the capacity to play a substantial role in the international negotiations on climate change.

We have a unique opportunity to show how tackling climate change can go together with a healthy economy and improved quality of life, and so encourage others to adopt the actions which are ultimately in the interests of us all.

Falling short on UK targets

The UK government has taken a commendable lead on climate change and gone beyond its commitment to cut emissions under the Kyoto Protocol. It has set challenging reduction targets for 2020 and 2050, which reflect more closely the scale of effort needed among developed economies to keep climate change within acceptable limits.

The growth in UK emissions over the coming years will be a lot lower than would otherwise have been the case, thanks to programmes that are already being implemented or which can reasonably be expected to happen in both the public and private sectors.

Electricity generation is set to become cleaner on current trends, as old power stations are replaced by modern gas-fired plants and through greater use of renewable energy. Major contributions are also due to come from continued efficiency improvements in industry and transport.

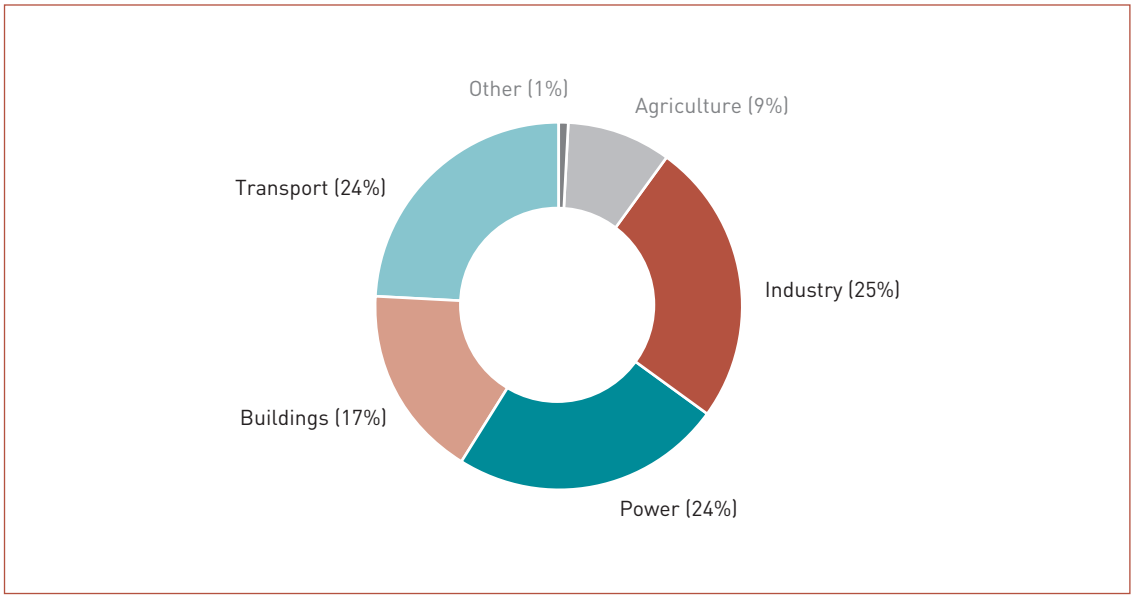
These are significant programmes. For example, the Advisory Council for Aeronautic Research in Europe (ACARE) has set a target for the aviation industry to cut carbon dioxide emissions per passenger kilometre by half between 2000 and 2020.

But even after allowing for these improvements, as things stand the UK is set to miss its objectives for 2020 and beyond. Our analysis shows that at best they will produce less than half the savings we need to meet our targets (see figure 3).

2%

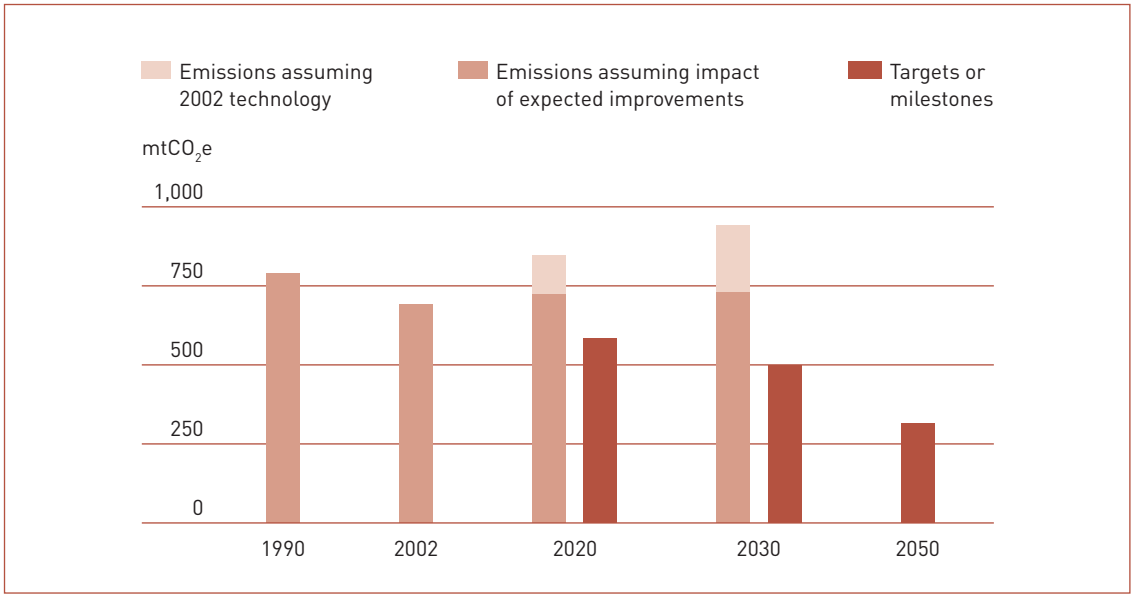
of global emissions occur in the UK but our influence is potentially more significant

Figure 2: Four sectors account for 90 per cent of UK emissions



Source: IPCC

Figure 3: Expected improvements are likely to produce less than half the emissions cuts needed



Source: McKinsey global cost curve; McKinsey UK cost curve; team analysis

The UK has emissions reductions targets for 2020 and 2050 but McKinsey also calculated the cut in emissions needed by 2030, assuming a linear projection between 2020 and 2050. The graph shows what emissions levels would look like in future, assuming no technological improvements and then more realistically assuming expected improvements come on stream, compared with the government's targets and 2030 milestone. Expected improvements do not include the possible impact of additional measures set out in the government's 2007 Energy White Paper, which we consider later in this report.


Concerted
action
needed now

We must more than double the emissions savings due from existing programmes in order to achieve our current goals

Getting on track to an energy-efficient, low carbon future

Urgent action is needed if the UK is to go further and make a significant contribution to international efforts to tackle climate change. We must more than double the emissions savings due from existing programmes in order to achieve our current goals. It may be necessary to do even more if, as some scientists now believe, further cuts in emissions will be required to keep the impact of climate change within acceptable levels.

Analysis carried out for the Task Force by McKinsey (see figure 4 and appendix 1) makes it clear what the UK needs to do by 2030. The analysis concentrates on this period rather than the longer term to 2050 since it is easier to quantify the costs and impacts of different measures over the shorter horizon.

The analysis is the first comprehensive study of its kind for the UK and sets out one possible pathway to a low carbon future. By 2030, nearly 60 per cent of the required emissions savings must come from more efficient energy use at home, in business and in transport. The rest must be the result of big cuts in the carbon emissions from the energy we use to provide electricity and heat or for transport.

Action to reduce emissions is needed on all fronts. Four specific areas offer the biggest scope for carbon abatement in the period to 2030 beyond that which we already expect to achieve (see figure 5):

- Emissions reductions in **buildings** (31 per cent) can be achieved through improvements in residential buildings such as wall and loft insulation and better heating controls, and full implementation of the government's plans for zero-carbon homes by 2016. More efficient appliances such as energy-saving

By 2030, nearly 60 per cent of the required emissions savings must come from more efficient energy use at home, in business and in transport

lighting and consumer electronics, efficient washing and drying machines, condensing boilers and refrigerators could also make a major contribution. Nearly one third of the abatement potential from buildings rests with commercial property, for example through better energy management systems and heating and cooling technologies.

- In the **power** sector (29 per cent), there are three big opportunities to cut emissions which become operational mainly in the period 2020-30. Greater use of wind (split evenly between on-shore and off-shore) is driven by government renewable targets. Carbon capture and storage (CCS) for gas and coal-fired power stations starts to make a real impact after 2020, and a new generation of nuclear power comes on stream after 2018.

- In **transport** (24 per cent), the bulk of savings comes from cars and goods vehicles through major advances in engine efficiency and related technologies. New power sources for road transport, such as electricity and biofuels, could also deliver significant savings. Improvements continue in aviation fuel efficiency, helping to limit the impact of growth in demand in air travel over the period to 2030.

- Significant opportunities for savings in **industry** (17 per cent) will come from improving manufacturing processes, by replacing conventional fossil fuels with low carbon sources of energy, biomass or waste; and to a lesser extent through the take-up of more efficient industrial equipment such as greater use of variable speed drives in compressors, pumps and fans. Most of the savings from this area could be delivered in the period up to 2020.

By 2030, against a background of annual GDP growth of 2-3 per cent, we will need at a minimum to move from a world where fossil fuels provide more than 70 per cent of UK electricity, to one where they account for closer to 50 per cent of power generation, thanks to investment in wind and nuclear power.

This will need to be accompanied by technologies to remove and store the carbon from fossil fuel power plants. As an example, all new coal-fired plants will probably need to adopt CCS from 2025.

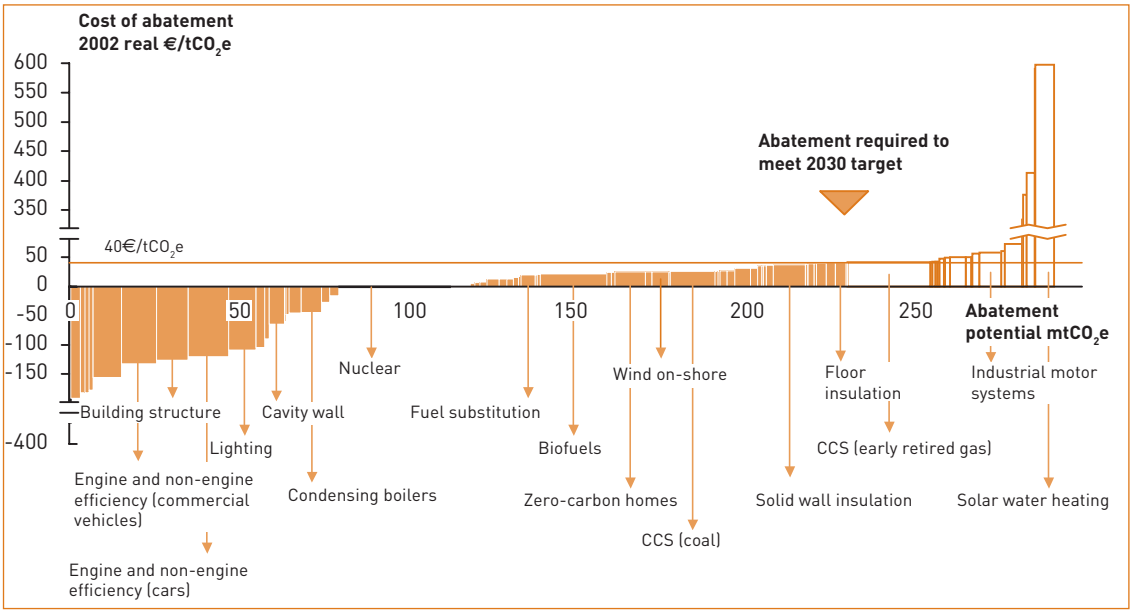
In 2030 electrical products will need to be at least 30 per cent more efficient than they are today, and emissions from the average new car will have to fall by at least 40 per cent.

The rate of change needed to achieve these outcomes is extremely demanding (see figure 6, page 14). It is clear we must act urgently to mobilise and manage significant levels of mainly private-sector resources in important areas of the economy to deliver emissions cuts.

The scale-up required in wind power, for example, is aggressive, comparable to the increase in wind power penetration which Germany achieved in the last decade. The replacement and expansion of the current fleet of nuclear power stations requires immediate planning if construction is to begin within the next five years. The building of 200,000 new zero-carbon homes per year by 2016 would also need to be accompanied by better insulation of existing homes at an annual rate possibly as much as three times that achieved in recent years.

In some cases, the challenge will be to remove the obstacles to delivering large-scale projects. In power, new sources of energy will need to be accompanied by major network investment, whether in a carbon dioxide pipeline grid to support CCS schemes or in upgrading the electricity transmission system to handle the operational impact of using more renewable energy.

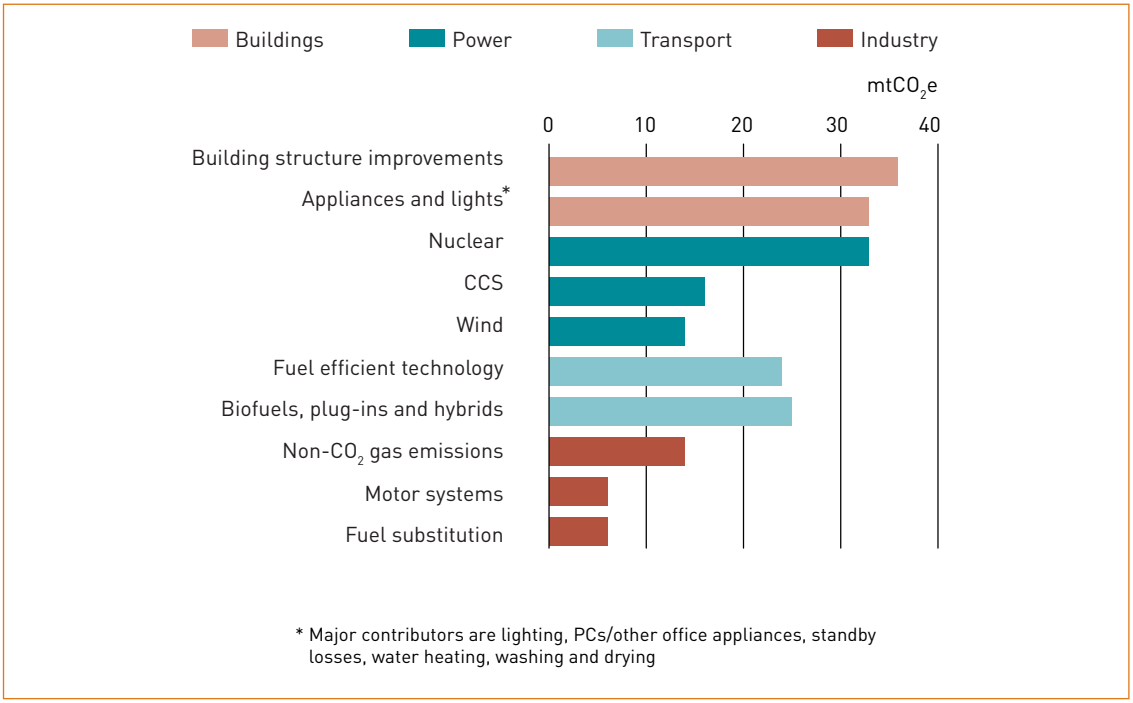
Figure 4: The UK cost curve for additional greenhouse gas reduction measures



Source: McKinsey UK cost curve; team analysis

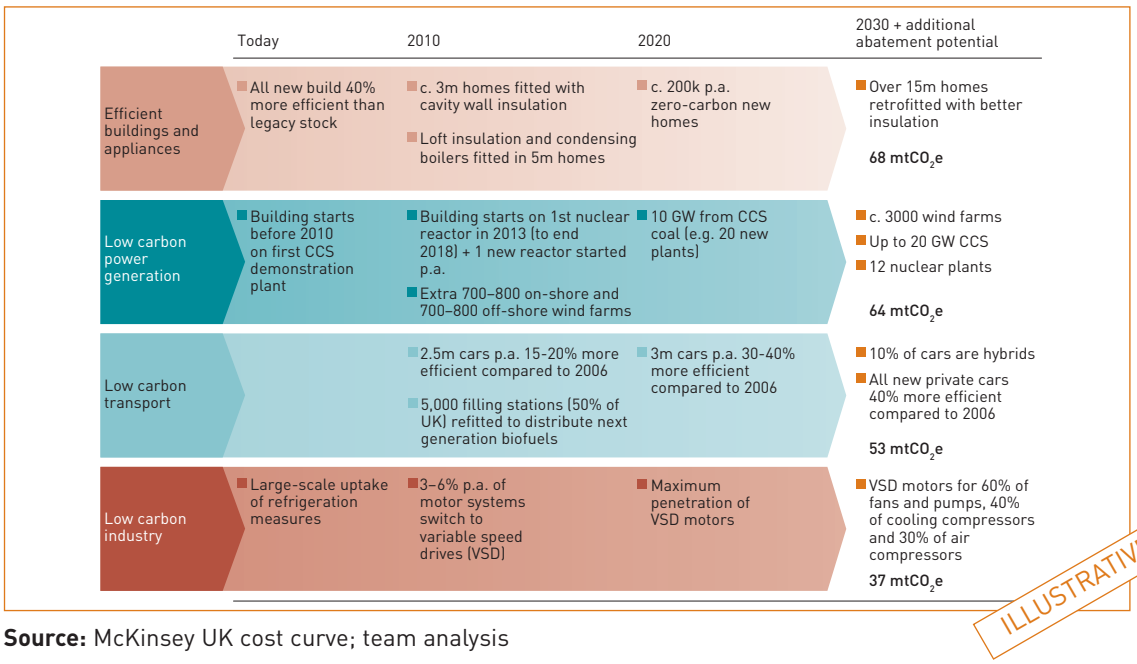
The UK cost curve shows the additional abatement needed and marginal costs to meet the UK's CO_2 targets. The cost is plotted on the vertical axis while the abatement potential is shown on the horizontal axis. The measures are arranged in order of cost, with the cheapest on the left, and the most expensive on the right. The cost curve is strictly a supply side view, and does not take into account a forecast of actual abatement demand.

Figure 5: There are significant abatement options in each of the four sectors



Source: McKinsey UK cost curve; team analysis

Figure 6: Timelines to meet the challenge are aggressive



Source: McKinsey UK cost curve; team analysis

In other areas, the task will be to influence the decisions of individuals related to the purchase of homes, cars and appliances – and how all these items are used on a daily basis. As we show later in this report, government and business will need to adopt a sophisticated mix of policies and measures to influence major investments in a wide range of technologies, as well as millions of smaller-scale decisions by the public.

The McKinsey analysis provides a guide to what should be done up to 2030, rather than a forecast. Within each of the four key abatement areas, it allows us to pinpoint the options which are likely to be most significant from a wide range of potential technologies. But it is possible that others could emerge over time.

In power, for example, it is clear that the biggest opportunities will come from technologies such as CCS, nuclear and wind. But tidal energy, energy from waste, fuel cells and hybrid systems which combine wind with power storage, are just some of the examples of technologies which might prove to be valuable sources of low carbon energy in the future. Greater use of micro-generation and combined heat and power (CHP) systems are further possible options relevant to both the power and buildings sectors.

In transport, the analysis indicates that biofuels hold significant potential as an abatement option. But much work still has to be done to ensure they deliver overall carbon benefits and to minimise any wider negative effects (such as their potential impact on other important uses for land like growing food).

Our review of abatement options in transport also helps set the debate about aviation in context. Air travel (international and domestic flights) represents just 6 per cent of UK emissions, but continuing growth in demand means that aviation will account for a bigger share of emissions over time.

Yet our assessment shows that with the right approach air travel can be part of a low carbon economy in 2030. Successful implementation of measures in other sectors is critical, but there are also practical options for containing aviation emissions in addition to the technological improvements already being taken forward by the industry.

For example, some 73m tonnes of carbon dioxide are wasted every year around the world due to inefficient use of airspace and infrastructure, such as the stacking of aircraft in the skies around Heathrow. Streamlining air traffic management systems in Europe could cut fuel consumption by 12 per cent. On the ground, most aircraft emissions are generated by on-board auxiliary power units: replacing these with fuel-cell systems currently under development could cut emissions by up to 75 per cent per unit.

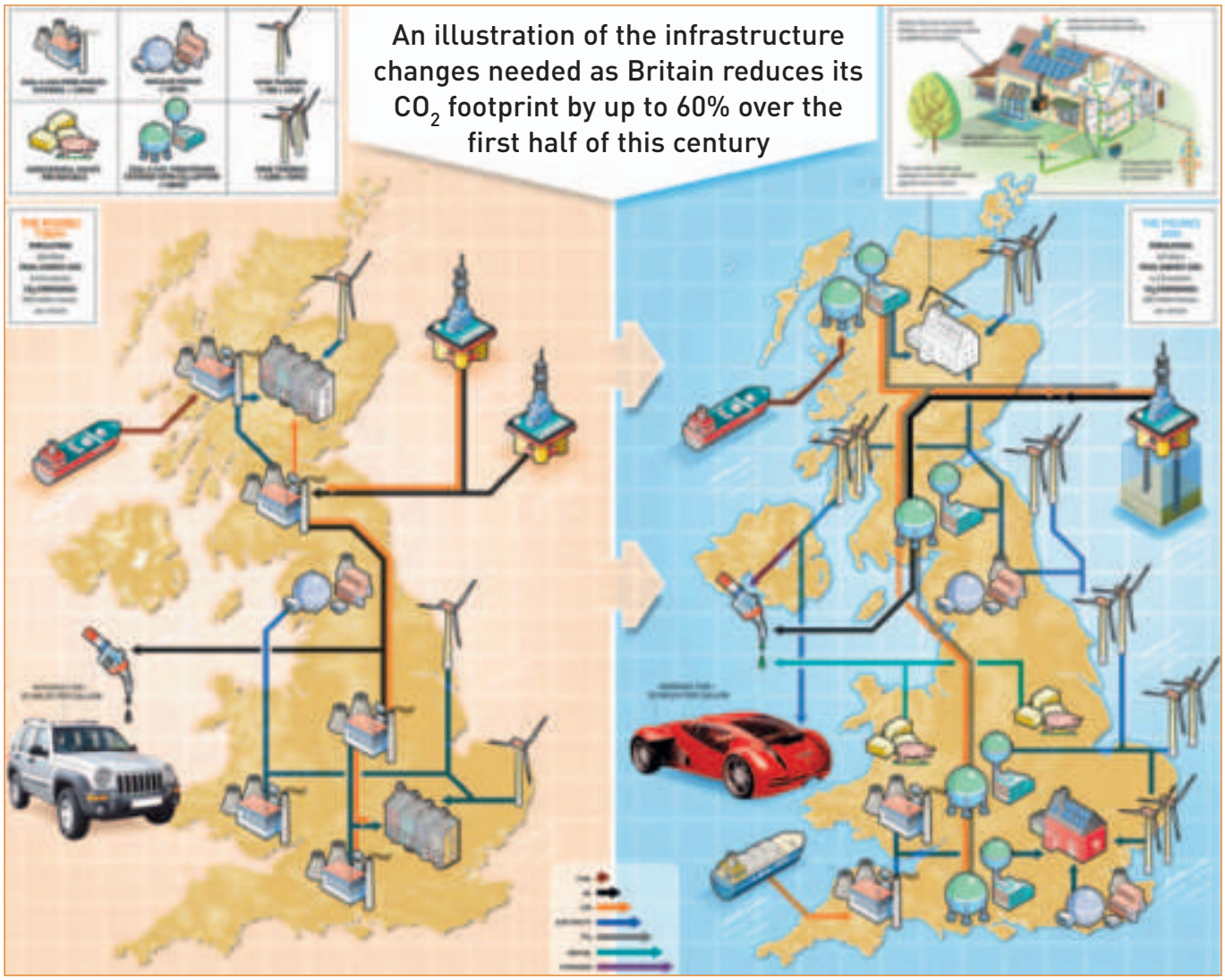
The longer-term pathway to emissions reduction across the economy up to 2050 is more difficult to map out with any kind of precision. However, work has been done nationally and internationally on this question. For example, Shell has put together a picture of what a low carbon UK could look like in 2050 (see figure 7).

This forward look should be seen as indicative rather than a forecast of what the future will be like. Key features include further energy efficiency improvements in different sectors (for example, average on-the-road vehicle efficiency would be twice that of today) and a sustained move towards electricity as the dominant energy source in the home and in commerce. The goal by 2050 would be to more than double the level of energy efficiency and halve the carbon content of the energy used in the UK economy compared with today.

These moves towards growing electrification of our economy have important implications. Fossil fuels would still play a significant part in meeting the needs

In 2030 electrical products will need to be at least 30 per cent more efficient than they are today, and emissions from the average new car will have to fall by at least 40 per cent

Figure 7: Energy for Britain – Today to 2050



Source: Shell

30%

of existing power-generating capacity will have to be replaced by 2025, creating opportunity for a lower carbon footprint

of industry, where gas is an important energy source, and in transport. However, while there could be scope for greater use of different types of distributed generation, increasingly the focus for reducing emissions would shift upstream to the power sector through continued adoption of CCS, renewable energy (wind, wave and tidal) and nuclear to generate electricity. This strategic transformation in our economy may take many decades to come about, but a consensus needs to develop that this is the right way forward, in order to start planning the right programmes now.

Concerted action now makes economic sense

Our analysis highlights the major changes needed in our economy to cut emissions at the scale and pace required to meet the government's targets. If we all make the right choices, these changes do not have to damage our way of life.

For example, many of the necessary technologies to cut emissions in the home or in business are already known to us. If car buyers today were to choose the most carbon-efficient car in class (rather than trading down from one class to another), this could cut emissions from the new car fleet by a third – and save on fuel costs.

It is true that implementing the full range of options needed to cut emissions will come at an additional cost. McKinsey analysis shows that in 2020 the maximum cost to save a tCO_2e could be over €60-€90. But by 2030, as more options become available and the initial cost of some expensive emerging technologies falls with time, then the price is more likely to be €40 per tCO_2e, as long as the full range and scale of initiatives are implemented.

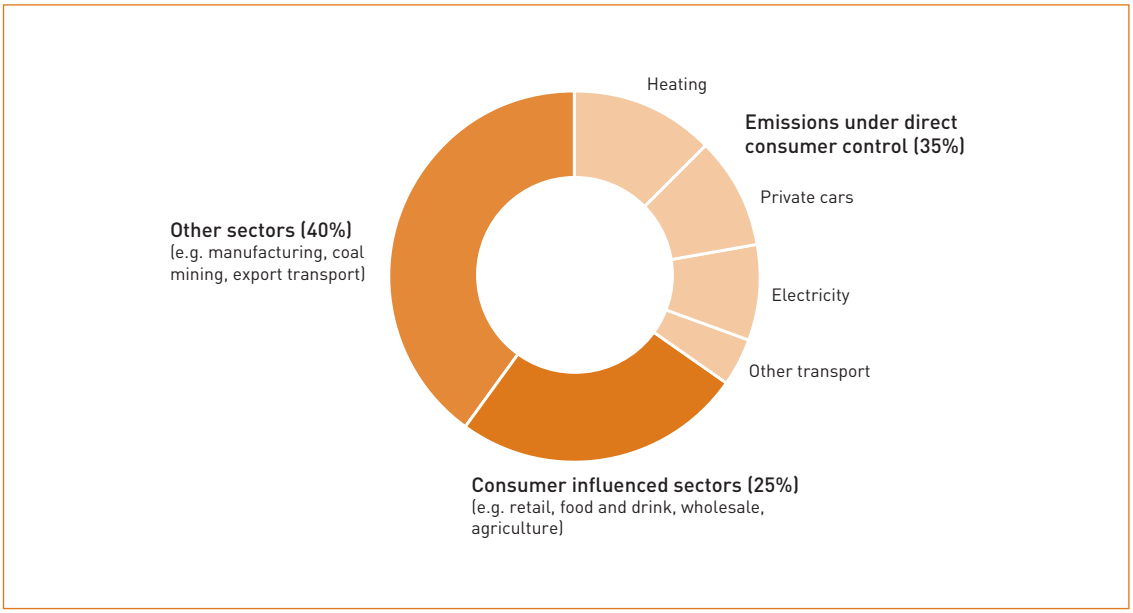
This translates into an investment of around £100 a year per household (under 1 per cent of GDP) by 2030. Some households would pay less than this, depending on things such as their current use of energy and how successfully they take up cost-effective measures to improve energy efficiency.

We believe that this cost is not only manageable but a sensible investment in our future, which will pay for a more sustainable way of life and shift resources to those parts of the economy providing low carbon products and services. Climate change will have to be tackled sooner or later and the earlier we get on with the job, the less likely it is to have damaging consequences for our way of life. And there is no better time than now to be making that investment.

The UK already has to replace more than 30 per cent of its existing power-generating capacity by 2025 as old plants are retired from service. A major programme of house building is an important social priority for the next decade. We have a unique chance to ensure that these major developments are not only delivered in sufficient time to meet the needs of society, but are also more carbon efficient than the assets being replaced.

Investing for the future also means taking action to protect our economy against the effects of climate change that are inevitable, no matter how successful we are in cutting emissions. We can already see signs of what the future might hold. Since the Thames Barrier was built in 1983 to protect London from flooding, it has been raised 55 times against tidal surges in the period to 2005 – of which 28 have occurred in the last five years. We need to make sure that our physical infrastructure is resistant to climate change, and that wider business processes are made climate-proof, dependent as they are on a global economy which is vulnerable to changing weather patterns (see appendix 2).

Figure 8: Consumers control or influence 60 per cent of emissions



Source: DBERR; DEFRA; ONS; IPCC; SDC; McKinsey UK cost curve; team analysis

The move to a low carbon economy will bring other risks to business. Some sectors – energy-intensive industries such as aluminium, steel and cement – will face increased costs, which could damage their competitive position. Businesses in this sector recognise they have important contributions to make towards emissions reductions, but it is vital that government policies take account of their circumstances and allow them to manage the transition.

Making the right choices for reducing emissions and for adapting to climate change will also provide us with a unique opportunity to develop new areas of wealth creation for the UK. If governments agree to an international framework to limit carbon emissions, the global market for climate change solutions could be worth $1trn in the first five years. And the UK economy has many relevant areas of strength on which to build (see boxes 2, 3 and 4):

- Established British businesses in information and communication technology, finance, aerospace, automotive, industrial and architectural design, and retail are well positioned to provide relevant products and services, and to generate the intellectual property and skills needed to function in this new global landscape.

- The UK also has an opportunity to be a world leader when it comes to adapting to the climate change that is already inevitable. British institutions are world-class in global climate prediction, and in other diverse sectors such as civil engineering, water treatment and pharmaceuticals.

- Opportunities also exist for smaller companies. According to one analysis, five key areas for SMEs – covering commercial buildings, renewable electricity, renewable road transport fuels, domestic energy efficiency and housing – could generate markets worth nearly £3bn in the period to 2010 in the UK.

Consumers, business and government need to work together

The range and scale of measures, affecting all aspects of society and the economy, will not be delivered unless consumers, businesses and government work together to cut emissions. The ability of each to make its contribution is very much interdependent and can be mutually supportive with the right approach.

Consumers have enormous potential to drive positive change. They directly control more than one third of emissions through personal decisions about how they heat and light their homes, the electrical appliances they use and the transport choices they make. Combining the emissions they can directly control with those that they influence through their purchasing choices, they have an impact on some 60 per cent of UK emissions (see figure 8).

With the right information and incentives, consumers can thus enable the market to drive cuts in emissions, by demanding more green products and services. They may also choose to make different lifestyle choices and change their travel, leisure and working patterns. This will stimulate competition and innovation among businesses in offering greener ways of doing things, and encourage them to reduce their own emissions. As consumers reward those that are green, in low carbon economy, business will have to be green to grow.

As voters, individuals can also be pivotal in driving the political debate. Making the transition to a low carbon economy will require the support of an informed electorate.

Business activities account for about half of all emissions in the UK. Large companies have a significant profile: the Carbon Trust has estimated that some 16,000, or 2 per cent, of firms account for 80 per cent of emissions from industrial processes and business use of buildings. SMEs individually have only a small carbon impact, but collectively they account for the remaining 20 per cent.

Firms of all sizes and in different sectors have the ability not only to curb emissions from their own operations but also to drive wider improvements in the UK and abroad, for example as purchasers of materials and services or, in the case of the financial sector, as investors in other businesses. They also have critically important roles in designing new low carbon products and solutions, and in helping employees and customers make choices which can in turn reduce their own emissions.

Government also has important direct and indirect roles to play in tackling climate change. The public sector is a major purchaser in its own right of goods and services, spending an estimated £150bn a year – or 12 per cent of GDP – on procurement of all kinds. Central government is responsible for around two-fifths of this total, while local government and the National Health Service are also very big spenders. The Task Force estimates that the public sector accounts for approximately 7 per cent of UK emissions, and the way in which it deals with its suppliers has an important bearing on how it manages its carbon footprint.

Ultimately, government has a critical role in determining how business and consumers can play their parts in tackling emissions. Its policies on tax, regulation, planning, innovation and public spending create the rules by which markets work. Government also has to work effectively with other countries to secure agreement on the critically important international action needed to tackle climate change.

2%

of firms account for 80 per cent of emissions from industrial processes and business use of buildings

Box 2: Major firms are already investing to capture low carbon opportunities

Climate change and the world's efforts to slow it will present a whole range of new business opportunities for UK plc. Across the world a number of corporations are already taking steps to develop the capabilities they need to capture some of these opportunities.

In the financial services sector, **HSBC** has announced that it will set up a Climate Change Centre of Excellence, as part of its $90m "Global Environmental Efficiency Programme". The centre will work with HSBC's global research heads and analysts to assess the financial implications of climate change and regulations to curb greenhouse gases. It will also support HSBC's carbon finance strategy, announced last year, under which it pledged to increase its financing for companies in the low carbon economy.

The property management division of **Prudential**, Prupim, is developing a web-based environmental reporting tool which will provide an energy monitoring and targeting system, enabling Prupim to reduce consumption where possible, and compare their performance against industry benchmarks. The aim is ultimately to deliver an industry-leading system that assists property managers in intelligent monitoring and targeting of environmental performance.

In the arena of consumer goods, **Ben & Jerry's** and **Unilever Research** completed a two year contract to fund the further development of research on Thermoacoustic Refrigeration (TAR). TAR is an alternative refrigeration technology that utilises sound waves to create cooling as opposed to traditional means of mechanical refrigeration that produce greenhouse gases.

Many businesses, from retail to insurance, require information on the likelihood of extreme weather events as well as help on how to adapt to longer-term climatic change. The **Met Office**, a world-class climate modelling centre, has recognised this opportunity by working with commercial organisations and offering consultancy services to businesses including finance and utility firms as well as foreign governments.

Box 3: London as a carbon finance centre

In recent years, London has gained recognition as a centre of carbon finance. The city's finance community led the way in 2002 by instigating the development of the Equator Principles, a benchmark for the banking industry to address environmental and social risks in project financing. More recently, investors (through the Institutional Investors Group on Climate Change) have done work with international bodies, such as the World Economic Forum, to develop global guidelines to improve the quality and consistency of carbon reporting.

The AIM securities market (part of the London Stock Exchange) has become a thriving international market for companies specialising in clean technology, providing a route for venture capital backed businesses into public ownership. Additionally, it is now home to over 70 clean technology companies, over 40 per cent of which are international. In terms of trading in credits under the existing EU ETS, London is the largest market for these instruments in Europe.

Box 4: Examples of UK SMEs that are at the forefront of low carbon products

Architecture has traditionally been an area of UK strength. **ZedFactory** has pioneered new methods of designing and insulating buildings, and developed the BedZed site in Surrey. Bill Dunster, the founder of ZedFactory, has since been asked by the Chinese government to design 140 new zero-carbon homes outside Beijing.

A Scottish company, **Pelamis Wave Power**, is behind the first wave farm in the world, recently established in Portugal. The Pelamis machines are a series of linking tubes, about the size of a small train, that point in the direction of the waves. As the waves travel down the tubes they cause the tubes to bob up and down. A hydraulic system turns this movement into electricity.

Shell Springboard provides up to £40,000 to selected small businesses that have potentially commercial ideas for products and services that contribute to tackling climate change. The aim is to encourage UK entrepreneurs to regard the challenge of climate change and energy transformation as a business opportunity. Judging panels select the most compelling plans for a product or service which will lead to greenhouse gas reductions. It recently commissioned a report to identify case studies of successful SMEs that had developed solutions for the low carbon economy. These examples cover a range of sectors:

- In transport, **CMR** has developed a method to modify single fuel cell technology to produce a much cheaper fuel cell than currently available. CMR is now listed on LSE's AIM market.

- **HeliSwirl Technologies** has developed a product that can reduce energy usage in a number of industrial processes. The technology generates a swirling flow that cuts friction in pipes, which allows for downsizing of pumps and reduces sedimentary deposits. Potential customers include petroleum producers, petrochemical processors, water distributors and the food industry.

- In the field of environmental electronics, **Enecsys** is a pioneer in developing ways of connecting energy sources such as solar, wind and fuel cells to the electricity grid. It has developed a system that allows the efficiency of energy supplied back to the grid to remain high, even when energy output is low. This technology will make domestic power generators more economically attractive for home owners.

Box 5: Task Force initiatives in buildings

In the UK in 2006, **Barclays** signed a contract with EdF Energy for the supply of electricity from a portfolio of different sources including wind, small-scale hydro, biogas, tidal and waste. The three-year deal will cut Barclay's carbon footprint by up to 125,000 tonnes of CO_2 a year, equivalent to the annual emissions from 19,000 homes in the UK. At its global headquarters in London, Barclays has developed the highest living roof in Europe specifically designed for local biodiversity and nature conservation. Green areas such as this absorb sunlight and heavy rainfall, reduce storm water runoff and act as building insulation to prevent heat loss in the winter.

At the new **Siemens** UK headquarters, intelligent technology has been installed to ensure minimal energy consumption. Lights throughout the building are designed to turn themselves on automatically when movement is detected and to dim or brighten according to the natural light in the office. The temperature, blinds and air-conditioning are also controlled centrally and the open-plan layout helps reduce the need for excessive air conditioning. Siemens estimates it will make an annual saving of 122.6 tonnes of CO_2, and cut costs by more than £34,000 a year from the new lighting alone.

Siemens is also undertaking work around the new Wembley stadium. This site is being redeveloped by Quintain which is incorporating sustainable and environmentally-friendly infrastructure into the new shops, entertainment facilities and residential flats being built in the area. In effect this is a new way of planning real estate to ensure that environmental considerations come as standard – and are not stripped out to boost profit margins. The Wembley project is potentially a blueprint for future urban schemes around the UK, not least the areas in East London due to be developed for 2012.

Bio Group is also pioneering innovative industrial building design which reduces emissions in manufacture and erection.

npower is working with business to provide green energy contracts for major energy users. It guarantees a range of sources, helping businesses reduce their exposure to taxes such as the Climate Change Levy. So far it has green energy supply deals with Sainsbury's, Woolwich, BT, Astra Zeneca, Marks & Spencer, Barclays and the Wembley and Millennium Stadiums. npower Juice is one of the UK's leading green residential tariffs, jointly developed with Greenpeace and serving nearly 54,000 customers. Since its inception in 2005, the npower Juice fund has invested over £2m in marine energy R&D.

One in seven people thinks (incorrectly) that turning appliances off instead of leaving them on standby uses more electricity

Vital issues must be addressed

For consumers, business and government to play their full part in meeting the national targets, five vital issues must be addressed.

People need better incentives

As consumers and voters, people need to be empowered to play their part. They need to know the facts about climate change. Consumers need information about the carbon content of the energy they use at home and on the move, and embedded in the products they buy. Products and services with a low carbon footprint should be made readily available at competitive prices and without compromising on quality. However:

- **Not all consumers are sufficiently engaged.** People fall within different groups. Up to a quarter of all consumers are conscious of green issues and take them into consideration when they can; around a third are not interested or are cynical about green issues; and then there are those in the middle ground who find it difficult to know what they should do to make a difference. Recent research suggests that UK consumers are more sceptical about the green agenda than their counterparts in countries such as Germany or France.

- **There is a lack of information and knowledge, as well as uncertainty about whom to trust.** Consumers are sometimes simply unaware of how they can make a positive contribution to reducing emissions. According to a recent survey by the National Consumer Council, one in seven thinks (incorrectly) that turning appliances off instead of leaving them on standby uses more electricity. The survey also points to the lack of information about the energy efficiency of products provided by some of the UK's major retailers. An investigation carried out by the Advertising Standards Authority in 2007 upheld consumer complaints about green claims made by a number of transport and energy companies. This highlights the need to strengthen public confidence in the information provided by businesses.

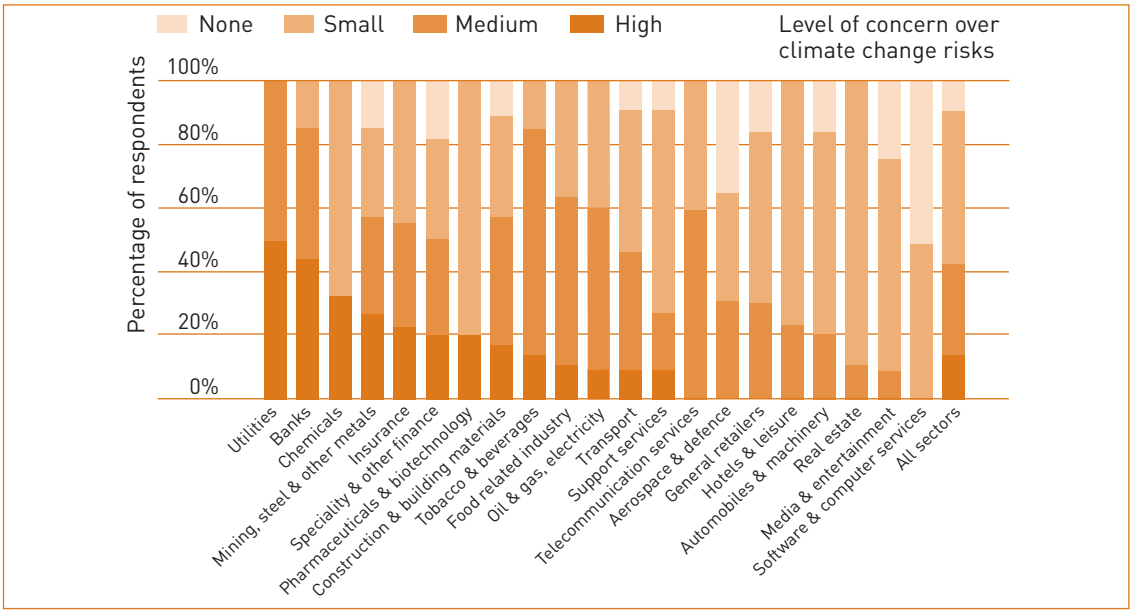
- **Some consumers might be willing to pay a modest premium for greener products, but at present most are primarily motivated by low prices or are unable to find the right products.** Even where paying more today can cut costs over the longer term, consumers typically look for a payback on their spending in under two years, which many abatement measures do not provide. Around 70 per cent of the opportunities to cut building-related emissions would deliver a lifetime net financial benefit through lower electricity and gas bills, but have payback times longer than two years. Finding energy-efficient products which also meet the expectations of today's consumers in terms of performance, for example, in the case of energy-saving light bulbs or plasma TVs, can also be a challenge.

Carbon needs to become part of the corporate DNA

Businesses, like people, also need information and incentives to take action. But they too face obstacles:

- **Business awareness and engagement is mixed.** The most recent report of the Carbon Disclosure Project (CDP5) revealed that over half the firms in the global FT500 say they are implementing emissions reduction initiatives. Yet a recent survey by the Economist Intelligence Unit of over 600 international senior executives showed that fewer than one in five firms had a carbon reduction plan. Surveys in the UK suggest that for 80 per cent of all SMEs and 40 per cent of major users, emissions reductions are not a priority. Of that number, half say they never will be. This is despite the range of support programmes run by bodies such as the Carbon Trust, or the fact that

Figure 9: The level of concern over the risks to business from climate change varies between sectors



Source: Acclimatise and UKCIP

UK businesses on average waste 30 per cent of the energy they buy and that improvements to commercial buildings, adoption of efficient appliances and better use of transport would save costs in many non-energy intensive sectors.

- **Few abatement projects can deliver a payback quickly enough for many businesses.** Larger-scale schemes which are project-funded are typically expected to give a return on investment in 2-5 years, yet companies often lack the resources to adopt these solutions. Smaller investments, such as energy-efficient boilers or advanced motor systems, are typically financed through company budgets, where other projects will compete for funding. These initiatives will often only be considered when equipment needs replacing at the end of its natural lifetime.

- **Businesses often lack the systems needed to manage or incentivise carbon-saving behaviour.** Among carbon-intensive firms responding to requests from CDP5 for information about their carbon performance, over a third had still not allocated board level or upper management responsibility for climate change. In manufacturing and engineering, 40 per cent of firms do not employ building and/or process energy management systems. In cases where businesses do not own their premises, there may be few incentives for tenants to pay for improved environmental systems.

- **Corporate reporting of emissions is on the increase but is still variable.** Around three-quarters of the global FT500 responded to CDP5, up from previous years. But reporting is not yet sufficiently comprehensive, consistent or comparable, making it hard for investors and others to assess performance or for companies to drive improvement through benchmarking. Only 38 per cent of the FTSE350 disclosed their direct (or so-called Scope 1) emissions, and just under half of these audited their data; few companies were able to establish their supply-chain (Scope 3) emissions other than business travel and external distribution/logistics.

- **Business awareness and management of the risks and opportunities from unavoidable climate change is only just developing.** Notwithstanding the impact of climate change which is already taking place, recent analysis of responses to CDP4 suggests that only 10 per cent of the FTSE100 said they considered the impact of climate change posed a high risk to their business operations (see figure 9). Some sectors, such as utilities, have a better awareness than others of the risks and opportunities, but among other potentially vulnerable sectors such as food, real estate and ICT, there was little concern.

An effective price for carbon is essential

Half of the options which the Task Force has identified will be economically viable in 2030 only if there is an appropriate price for carbon which rewards action to cut emissions. Analysis done for the Task Force by McKinsey suggests that a carbon price of €40/tCO_2e in 2030 is needed to bring forward the full range of abatement options needed.

A price can be set implicitly, by imposing regulations on the carbon content of products and services or by imposing obligations on companies to take action to cut emissions. Well-designed regulation can be effective, particularly where there are many small emitters and where suppliers can work over reasonable timescales to deliver clearly-specified goals.

Price can also be set explicitly, either through taxes or by creating a market in which participants have emissions quotas which they can meet by buying and selling allowances. Taxes can be a simple way of fixing

30%

of the energy businesses buy on average is wasted

Box 6: Task Force initiatives to reduce emissions from business operations

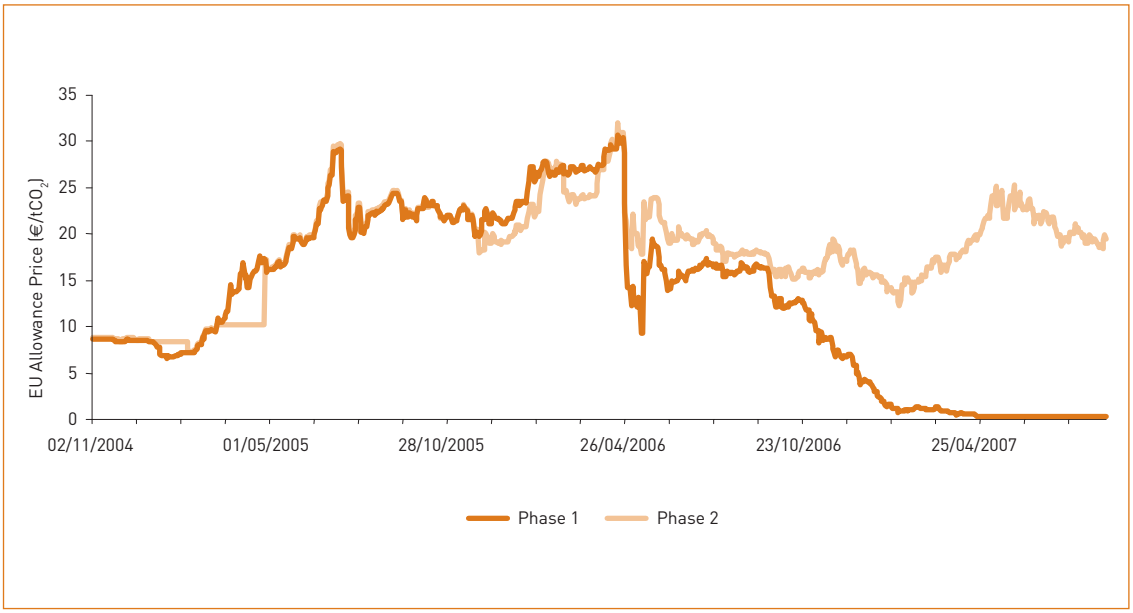
Some Task Force members have established their own emissions targets. One example is **BT** which has already reduced UK CO_2 emissions by 60 per cent since 1996 and now plans to reduce emissions by 80 per cent by 2016, against a 1996 baseline. **BP** cut its operational emissions by 10 per cent between 1998 and 2001, representing a reduction of nearly 9 $mtCO_2e$ per year. It has continued to deliver reductions of about 1 $mtCO_2e$ per year since 2001 and estimates that it has created almost $2bn of net present value since it began focusing on internal greenhouse gas emissions in 1998. Many companies, such as **Corus**, **BT** and **Aviva** have established internal teams to investigate, manage and monitor how they are responding to the climate challenge. Aviva has cut emissions by over 17 per cent since 2001 (despite the acquisition of the RAC) and through offsetting was the first insurer to become carbon neutral on a worldwide basis.

Businesses are also working on ways of reducing emissions across their supply chains. **BT** has recently tightened environmental criteria in its approach to procurement – covering the energy consumption and environmental impacts of products and services, from manufacturer to usage and disposal. **Tesco** announced at the start of the year that it would begin the search for a universally-accepted and commonly-understood measure of the carbon footprint of every product it sells, looking at its complete life cycle from production, through distribution to consumption. **Bio Group** has launched an initiative to persuade suppliers to source renewable energy, and where appropriate will adopt this as a supplier requirement.

Business has also been actively seeking ways to engage its workforce and customers. For example, **BT** has established carbon clubs for its workforce and **Aviva** has established a climate change toolkit for employees. **Tesco** has appointed an Energy Champion in every larger store, who is trained to identify where energy is being wasted and to take appropriate action. It is also investing in sustainable technology such as wind turbines, CHP and ground source heat pumps, as well as helping customers go green, for example, by halving the cost of energy efficient light bulbs. **BP** has launched a carbon calculator to enable customers to estimate the carbon emissions caused by their own lifestyles. BP has also produced new materials on climate change for use in UK schools. **npower** recently launched its Green Schools campaign, with an investment of £20m. Part of the programme directly engages children through its "Climate Cops" characters. The programme will also help teachers achieve curriculum-learning objectives and make their schools greener through energy audits and other help.

Barclays recently launched Barclaycard Breathe, which is specifically aimed at encouraging the purchase of greener goods through discounts from a range of businesses. In addition, 50 per cent of profits from the credit card go to projects tackling climate change. Barclays is also the largest trader within the London market for EU ETS credits. **Bio Group** has committed to opening a visitor and education centre on every facility it builds. Each centre will focus on climate change, sustainability, water as a precious resource and renewable energy, and will establish links with local schools and communities.

Figure 10: The price of CO_2 under the EU ETS



Source: Climate Change Capital

a price for carbon which can be adjusted in the light of experience about their effectiveness in delivering emissions reduction.

All of these options have a role to play, and are deployed in the UK. One of the most important is the EU ETS, which covers about half of the EU's CO_2 emissions and applies to just under 700 installations in the UK.

We believe that cap-and-trade schemes, such as the EU ETS, have several distinct advantages over taxation as a measure focused on large emitters in the power and industrial sectors. By setting a cap on emissions for those sectors within the scheme, they offer certainty about the level of reduction which will be achieved. And despite calls for a global carbon tax, international agreement for a global cap-and-trade system currently looks very much more likely.

Ultimately, allowing companies the flexibility to trade their allowances is likely to be more effective in delivering carbon reduction at the lowest overall cost, particularly if the EU ETS paves the way for a global market for carbon. The creation of the EU ETS has been an important achievement and now needs to be developed in order to deliver on its potential:

- **The price of allowances under the EU ETS so far has generally been too low compared with what will be needed to help reward investment in more expensive abatement options** (see figure 10). Shortcomings in Phase I of the EU ETS, such as an overall cap on emissions which was set at too high a level, have started to be addressed (for example, through a tighter cap for Phase II to 2012). But uncertainty about the precise form which the EU ETS will take once the current phase comes to an end in 2012 (for example, in terms of the overall cap and how allowances are allocated), remains a problem.

- **The interaction between the EU ETS and other policy initiatives is unclear.** It is not known how heavily the EU intends to rely on the EU ETS in order to deliver its overall goal of cutting greenhouse gas emissions by 20 per cent by 2020. And it is not clear how the EU ETS will interact with other policy objectives, such as the EU's goal of sourcing 20 per cent of all its energy from renewables by 2020. The outcomes could either significantly depress or increase the EU ETS market price.

- **The current lack of a global market for carbon poses serious risks for some sectors covered by the EU ETS.** Energy-intensive companies operating in internationally traded sectors and covered by the EU ETS, for example, in iron and steel, or cement, are faced with a carbon price which does not apply to their competitors operating outside the EU. It is difficult to estimate the precise impact this will have on different sectors, but it could be enough to make some industrial processes in the EU uncompetitive particularly if, as will be necessary, the overall cap is tightened. This could potentially encourage production to relocate elsewhere, which would not help to reduce global emissions but which would cause considerable damage to the European economy.

Half of the measures which the Task Force has identified will be economically viable in 2030 only if there is an appropriate price for carbon

Box 7: The impact of carbon price on competition

Setting a price for carbon in the UK will add a variable cost to many manufacturing processes. While this is meant to incentivise increased efficiency and lower emissions, it may also cause significant disadvantage to UK companies competing on the global market, as many of their competitors will not face similar increases. Some of their non-EU competitors can already rely on lower labour costs or can afford to accept lower margins than UK listed companies.

It is difficult to quantify how much impact the ETS might have on competitiveness. Some reviews of the current EU ETS have found limited average impact, but they assume 95 per cent of required emission allowances are granted for free. Even then, the impact for some specific sectors can be large. In the steel sector, for example, there are two main production processes, both of which generate significant emissions but in different ways. A carbon price of €20 per tCO_2e could increase the marginal unit cost of one of the processes by 17 per cent but would have only a minor effect on the other.

Some reports base their analyses on historical data and argue that the negative impact may be limited to just a few sectors, such as steel, while most other sectors, such as power generation, will be able to pass on costs to their customers. However, while it may be possible for power generators to do this, the ability of other sectors to pass on such costs may be far more limited as it will depend on competition and the elasticity of demand.

Even if the impact is limited to a few sectors, for them the concern is very real. The winter of 2005-06 brought a large spike in the price of natural gas, resulting in severely increased costs for many manufacturers and leading to the closure or mothballing of several paper mills, glassworks and chemical plants. This suggests that the impact of a high carbon price could be substantial on some industrial sectors.

More focus and greater effort is needed to promote R&D in technology

The McKinsey analysis underlines the critical role that technology will have to play in delivering the emission cuts necessary to hit the government's targets. Many of the options involve technologies which are already known but are not yet commercially viable, and which depend critically on R&D for their successful implementation.

R&D can cover a wide range of activities prior to commercial implementation, from pure science through to practical demonstration and then early-stage deployment. These activities are important for a wide range of low carbon technologies. Demonstration is now critical for the future success of CCS and zero-carbon homes. Measures to encourage early deployment are particularly relevant for the latest generation of energy efficient cars and consumer appliances.

Other approaches to lower carbon emissions will also need to be developed. Many of these are likely to come via service innovations and different business models (such as the potential to develop energy service companies in place of conventional energy suppliers). Significant gains are also likely where services can be combined with new technologies to create solutions that are both user-friendly and help change user behaviour.

An effective carbon price is a vital incentive for firms to invest in innovation. But such a price does not yet exist, and even when it does in many cases it will still not be high enough to compensate for the range of technical and commercial risks involved in developing new applications. Our analysis shows that in 2020 the marginal price for reducing carbon might be as high as €60-€90. Yet the carbon price required to justify some technologies – covering up to 10 per cent of the abatement opportunities then available – could be significantly higher than even that.

Moreover, although the costs linked to early-stage research can be low, the risks are substantial, and costs accelerate as a technology moves to the demonstration phase, particularly in capital-intensive industries (see figure 11). For example, product development for a new aero-engine can cost $1bn-$2bn and the initial technology investment may take place 10-20 years before this stage.

UK companies in sectors as diverse as power, aerospace, automotive, construction and ICT are involved in significant R&D activity, often jointly with government and international partners. Government programmes which encourage R&D can take many forms other than public spending and have a critical role to play in helping companies manage the risks which they face in moving along the technology curve in Figure 11. But there are problems to be resolved:

- **The government's approach to R&D lacks coherence.** Government environmental policies span the full range of R&D activities but to date have been insufficiently focused on options which have a reasonable chance of being brought to market. There is a particular need for greater focus on promoting demonstration and early deployment of low carbon technologies. Government support for private sector investment consistently varies in structure and approach, involving a wide range of agencies throughout the process which works against sustained private sector investment in R&D.

- **The government needs to do more to win the confidence of private sector partners in developing energy technologies.** The recent competition for a CCS demonstration project has left some major companies unhappy about how the process was handled. A particular concern is the decision to limit support to a particular form of CCS rather than the wider family of potential CCS options. Securing government assistance can also take too long. For example, the Technology Strategy Board's procedures involve a one to two year lead-time between the original idea and the start of a contract, and it is also expected to be two years before the new Energy Technologies Institute launches its first programmes.

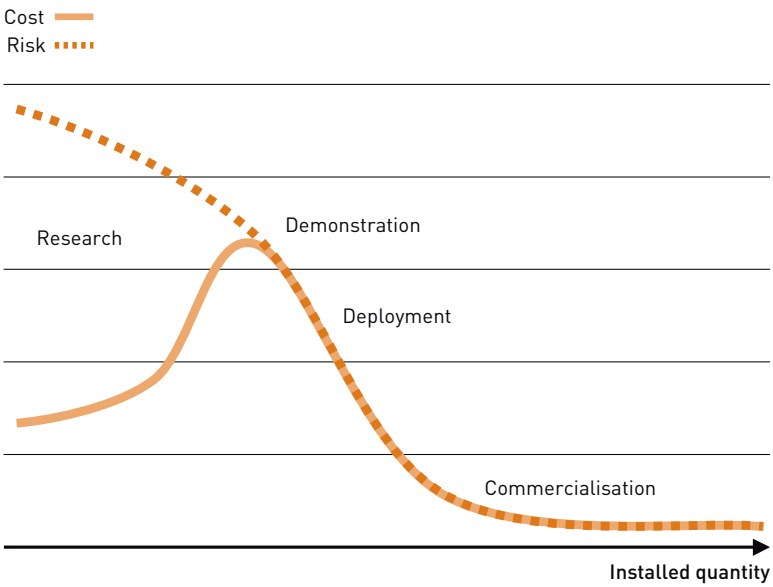
- **The level of public spending for R&D does not match the scale of the challenge.** The UK currently spends 1.78 per cent of GDP on R&D compared to 2.67 per cent in the USA and 3.17 per cent in Japan. Although in some sectors the UK does well in terms of R&D intensity (that is, as a share of sales) and public funding for energy-related R&D as a share of GDP has risen in recent years, the latter is still among the lowest in Europe (at about one third of the EU average of 0.17 per cent).

This has to change. Shell, for example, has argued that the government should be prepared to channel up to £2bn over the next five years into large-scale demonstration of CCS. However, the total annual spend of the Energy Technologies Institute is likely to be no more than around £100m. The Society of British Aerospace Companies has called for government investment in civil aviation technology of £130m-£150m per year, funding which would be heavily biased towards environmental technologies. The recent creation of the Innovation Platform for Low Carbon Vehicles is welcome, but its funding (£20m) falls far short of the support seen in France, Germany and Sweden.

Other obstacles need to be tackled

Even given an effective carbon price and sustained support pushing emerging technologies towards commercial feasibility, there will still be other obstacles to the introduction of abatement opportunities. Significant barriers to implementation

Figure 11: The largest cost of developing technologies is often at the demonstration phase



Source: Interviews; team analysis

The commercialisation of a technology follows three stages of development. In the first, cost is not the main issue for a company, but the risk of failure is high. The biggest financial hurdle comes at the demonstration phase – the start of the deployment process, when costs are usually highest. As the technology is progressively rolled out, uncertainty about the outcome and costs decrease, until in the third phase the technology is fully commercialised.

exist, in some cases through the lack of appropriate standards and regulation or through shortcomings in the existing regulatory regime:

- **The planning system is holding back delivery of low carbon power solutions.** Our analysis has identified major potential for wind and nuclear power to provide low carbon sources of electricity. Yet as the government has recently admitted, there are today 56 wind farm projects with a collective potential for generating 4 GW of energy that have been stuck in the planning system for over two years. If these projects had been approved and were now operational, they would be producing electricity equivalent to that used by over two million homes. The planning process for the last nuclear power station built (Sizewell B) took approximately 6 years to conclude.

- **Other important technical issues affecting the delivery of power solutions need to be resolved.** For CCS, these include developing standard rules and measurement protocols, and resolving the question of long-term liability for stored carbon dioxide. In the case of wind power, decisions are needed on the offshore transmission regime which has been under discussion since 2001. For nuclear power, decisions need to be made on which technologies are to be approved and on waste management.

- **The regulatory regime for road transport emissions is not yet delivering the necessary results.** The voluntary agreement between the EU and car manufacturers has delivered improved new car fuel carbon efficiency but will miss its 2008 target. In the UK, the carbon performance of new cars has also improved, but remains below the EU average. A successor to the current voluntary agreement for cars is being debated but has yet to be agreed, as is also the case for plans to improve the carbon performance of vans (a fast growing area of UK transport emissions).

- **Major decisions are needed to realise emissions savings in buildings and the use of appliances.** Widespread introduction of smart metering in homes and small businesses is unlikely without a government mandate, while agreement has yet to be reached under the EU Energy Using Products Directive on assessing and minimising the impact of products over their life cycle. Member states are unlikely to implement the directive until 2009, and even then it will not impose directly binding requirements.

- **Workforce skills need to be developed across the economy.** Greater demand for low carbon goods and services will attract new talent over time, but in the short term there are skills gaps to be tackled in important sectors. These range from technical specialists (for example, in the nuclear sector where the UK could be competing with other countries for staff), to designers, engineers and electricians as well as appropriately trained sales staff in the retail sector, and project managers specialising in delivering a range of mitigation and adaptation solutions.


Making
it happen

The Energy White Paper and plans to introduce legislation before the end of 2007 are welcome but there are questions about how far in practice they will deliver

Current public and private sector initiatives need to go further

The government is actively pursuing a range of initiatives aimed at delivering its targets. Box 10 summarises some of the main policies, including those announced in the 2007 Energy White Paper, which come on top of the existing set of climate change measures.

The government believes that the UK will just achieve its target range of emissions reduction by 2020 – a cut of 26-32 per cent compared with 1990 – as a result of its White Paper programme. This assumes that all its measures are fully implemented and that they achieve emission savings at the upper end of its estimates. The government is also taking forward a Climate Change Bill to make its 2020 and 2050 targets statutory, and to create a Climate Change Committee to advise on progress, which we support.

A significant amount of private sector activity is also taking place within the UK in response to the climate change challenge. Task Force members themselves are taking forward action in each of the four main abatement areas (see boxes 5, 6, 8, 9 and 11), and there are many examples of initiatives which bring together business, consumers and government:

- The *We're in it together* campaign brings together 10 companies and public sector partners in a three-year campaign to encourage consumer action by offering carbon-saving products and advice. The Carbon Trust and the British Standards Institute (BSI) are working with a wide range of companies to develop a standard for measuring the carbon content for products and services, as well as looking at how best to communicate that information to consumers.

Box 8: Existing and expected climate change initiatives in the UK

	PRE-ENERGY WHITE PAPER	ENERGY WHITE PAPER	PBR/CSR 2007	OTHER
BUILDINGS (INCL. APPLIANCES)	• Supplier Obligations (e.g. EEC 1 & 2, CERT, fuel poverty) • Energy efficient products • Building regulations (commercial & residential) • Climate Change Levy • Carbon Trust and other business support programmes (e.g. SME loans)	• Energy Performance in Buildings Directive (commercial and residential) • Zero-carbon homes • Smart metering (commercial and residential) • Energy efficient products • Carbon Reduction Commitment	• Business rates for micro-generation	• Consumer campaigns e.g. *Act on CO_2* & *We're in this together* • Company commitments & private sector initiatives (e.g. BPF & Carbon Trust on commercial property) • Private sector R&D • Government Sustainable Procurement Action Plan
POWER	• EU Emissions Trading Scheme (ETS) Phases I & II • Renewable Obligation (RO) • Technology-specific grants	• Carbon Capture and Storage demo project • RO changes • EU ETS Phase III + • Planning Bill • Energy Bill • Energy Technologies Institute	• Environmental Transformation Fund increase • Technology Strategy Board • 2008 Low Carbon Energy Technology Strategy	• Private sector R&D
TRANSPORT	• Renewable Transport Fuels Obligation (RTFO) • EU Voluntary Agreement (cars) • 10 Year Plan (e.g. public transport) • Sustainable Distribution • Fuel Duty Escalator (to 2000) • Vehicle Excise Duty • Company Car Tax • Air Passenger Duty	• Successor to EU Voluntary Agreement • RTFO extension • Low Carbon Vehicle Innovation platform • EU ETS – aviation (possibly also surface transport & shipping) • Energy Technologies Institute	• Technology Strategy Board • APD changes • Company car fuel benefit changes	• Consumer campaigns e.g. car CO_2 labelling and *Act on CO_2* • ACARE & Sustainable Aviation • Private sector R&D • Company commitments & private sector initiatives (e.g. logistics) • Public transport operator initiatives (e.g. rail) • Government Sustainable Procurement Action Plan
INDUSTRY	• Climate Change Agreements (CCAs) • Climate Change Levy • EU ETS – Phases I & II • Enhanced Capital Allowances	• EU ETS Phase III +	• Technology Strategy Board • CCA extension	• Private sector R&D

Source: DBERR; PBR and CSR 2007

The clear risk is that without significant financial and policy support to promote emerging technologies with commercial potential, abatement opportunities will not be implemented in the shorter term

- Investor pressure is increasingly being used to encourage businesses to tackle their emissions. One large institutional investor recently engaged with a group of companies that had persistently not disclosed their carbon footprint as part of the annual Carbon Disclosure Project questionnaire: over half subsequently provided a full answer and others provided some information. Other investors are working with companies to encourage appropriate action and enhance the market value of their business. In a separate initiative, 37 UK trade associations have signed the Trade Association Forum Declaration on Climate Change, committing themselves to internal action and to work with their members and other organisations to cut emissions.

- The government has launched the Energy Technologies Institute (ETI) as a 50:50 partnership between industry and government, investing £1.1bn in low carbon technology over the next 10 years. This involves a number of Task Force members. The Information Age Partnership has set up a working group bringing together government and industry on ICT and environment with a particular focus on climate change, which is due to report in 2008.

These initiatives are very welcome. The White Paper has been a positive response to calls from the business community for clarity on how the government intends to move towards achieving its climate change goals, while also meeting other vital goals such as ensuring security of energy supplies. The government's plans to introduce legislation on climate change, energy and planning before the end of 2007 is welcome recognition of the need for urgency.

But the analysis carried out for the Task Force raises questions about how successful in practice the combination of existing and additional measures in the White Paper will be in delivering the 2020 target.

Although our assessment is not directly comparable to the government's White Paper analysis, it does share some similar assumptions about the potential impact of specific technologies and the broad scale of overall effort needed to achieve the target (see appendix 1). Yet we believe the White Paper is over-optimistic about what it can deliver, for a number of reasons:

- We believe some of the baseline assumptions in the White Paper about savings from existing measures are overstated. For example, we think progress can be made by 2020 to increase the use of wind power and to improve domestic energy efficiency, but not to the extent the government believes possible without further action to encourage implementation in areas like planning or the energy performance of existing homes.

- In the case of additional savings from measures announced in the White Paper, much emphasis is rightly placed on important measures such as the EU ETS and a successor to the current voluntary agreement for reducing emissions from new cars. But decisions on the future of both measures, which to date have not fulfilled their potential in terms of reducing emissions, have yet to be agreed at EU level.

- Our assessment suggests that the marginal price in 2020 of additional measures adopted in the UK would be at least €60-€90/tCO_2e. This is high compared with a price of €40/tCO_2e in 2030 indicated by our analysis and also depends on full implementation of all measures – which is itself a challenging assumption. The clear risk is that without significant financial and policy support to promote emerging technologies with commercial potential, abatement opportunities will not be implemented in the shorter term.

Box 9: Task Force initiatives in the power sector

npower already operates 460 MW of renewable energy and has announced a £1.7bn investment in new low carbon power generating capacity as well as the upgrade of existing capacity that will reduce CO_2 emissions per unit of power generated by 50 per cent by 2015 compared to 1990 levels. It has also announced an initial £8.4m investment to fund plans to design the first CO_2 capture plant at a UK coal power station in South Wales, the first phase of which could be operational by 2010. Further investment is planned to support a larger CCS demonstrator plant of at least 25 MW.

Shell is also involved in a number of projects to prove CCS technology. These include the ZeroGen project in Queensland, Australia in which up to 70 per cent of the plant's CO_2 emissions could be captured and stored.

CCS and hydrogen power are a key part of **BP**'s growing low carbon power generation business, BP Alternative Energy. This business, launched in 2005, combines BP's interests in hydrogen power with BP Solar, its photovoltaic company, and interests in wind power and natural gas-fired power generation. BP anticipates investing some $8bn in BP Alternative Energy over the decade to 2015.

Shell and partners hope to build what would be one of the world's largest offshore wind farms in the outer Thames estuary. This wind farm would produce enough low carbon electricity for the equivalent of 750,000 homes or about a quarter of the homes in London. **Barclays** has financed a community wind farm in Ayrshire, which is expected to generate enough renewable electricity to power 13,000 homes each year.

In the event that the UK does not adopt all abatement options in the short term, the government's 2020 target could still be met by buying credits generated by overseas emissions reduction projects to make up any shortfall. While this would be a reasonable thing to do, it risks making it more difficult or more expensive for emissions reductions in the UK to be on track by 2030 without greater reliance in future on buying further overseas credits.

Greater efforts will also be required to adapt our economy to cope with the climate change that is already inevitable. The Association of British Insurers (ABI) has warned that public spending plans on flood defences are inadequate and that the government needs to bring forward plans to spend £800m in the period 2010-11 so that higher investment can start immediately.

What matters now therefore is delivery. Critical decisions affecting each of the main abatement areas need to be taken in the next two to three years, to convert policies and initiatives into actual emissions reductions at the scale and pace needed to hit existing emissions targets, let alone achieving tougher ones. This in turn calls for a new approach to the challenge.

A new partnership where carbon becomes the new currency

The government has taken a commendable lead on climate change. But neither the act of setting targets nor the power of market forces will by themselves be enough to do the job. We need a new policy framework in which government, business and consumers can work together towards a shared national objective.

Box 10: Task Force initiatives in the industrial sector

Corus is promoting a global sectoral approach to tackling climate change aimed at engaging the global steel industry through the International Iron & Steel Institute (IISI). At the European level, Corus is also playing a leading role in developing a sectoral approach to emissions trading after 2012. The next stage of IISI's initiative towards a global sectoral approach for steel involves the collection and reporting of CO_2 emissions data by steel plants in all major steel-making countries.

Corus is also involved in ULCOS (ultra-low CO_2 steelmaking), a £38m multi-partner R&D project that has been established to develop potential breakthrough technologies that could bring about a step-change reduction in CO_2 emissions. Examples of the new technologies being investigated include smelting reduction, electrolysis and the use of hydrogen.

INEOS has recently invested more than £390m to modernise its plant at Runcorn, employing state-of-the-art membrane technology which is significantly more energy-efficient than the older mercury technology and replacing an old inefficient power station with a new boiler plant, reducing emissions by more than 150,000 tCO_2 per annum. This new investment has made it possible for INEOS to adopt even more stringent Climate Change Agreement targets – the previous target of a 7 per cent improvement by 2010 was replaced in 2004 by a target to improve energy efficiency by 12 per cent by 2010.

Bio Group plans to invest £100m over the next five years, building and operating facilities which convert organic waste into renewable, sustainable energy and products for soil conservation and carbon sequestration. This will generate up to 70 MW of renewable energy per annum. This equates to energy for at least 180,000 people.

INEOS is planning to build a 100 MW energy-from-waste combined heat and power plant to reduce its dependency on fossil fuel at its operations in Runcorn.

BT and **Ford** are using green energy sources to provide all or part of their energy. Ford established London's first large-scale wind power project at its plant in East Dagenham: the two 1.8 MW turbines annually displace over 5700 tonnes of CO_2 and a third machine is now in planning. BT recently unveiled plans to develop wind farms aimed at generating up to 25 per cent of its existing UK electricity requirements by 2016 (the biggest wind project undertaken by any non-power company in Europe).

Rolls-Royce is designing and testing a fuel cell system to generate electricity which will power buildings such as hospitals and universities. The fuel cells will use a range of fuels including natural gas, biogas and ethanol. The system, which incorporates technologies derived from the company's aircraft engine expertise, is very quiet and therefore ideal for use in urban areas. It can be entirely recycled at the end of its useful life. The first system is scheduled to run in 2008 and will produce 1 MW of power.

The key to this approach lies in clearer recognition that success depends on managing and implementing a broad set of abatement opportunities, involving many players. Government has to deploy the full range of public policies, including tax and regulation, and ensure that its initiatives are implemented quickly. Businesses must show leadership in managing their own emissions, and in developing competitive green products and services.

An effective price for carbon needs to be factored into all spending decisions by government, business and consumers. Carbon has to become the new currency of our economy. Substantial investments backed by both public and private funding will be required in new technologies like CCS.

As things stand, the machinery of government will struggle to manage projects on this scale and to time. Responsibility is spread across many departments, committees and regional agencies, along with a small army of quangos. The House of Commons Environmental Audit Committee has called for a review of government action in the area of climate change to provide the needed clarity about responsibility for developing and delivering policies.

The private sector also faces an enormous task in mobilising and managing the level of resources needed to respond to climate change. Delivering infrastructure and technologies in areas such as power or transport will depend on world-class management of funding, expertise and manpower, both within the UK and along global supply chains.

Government and the private sector have to find a way of developing coordinated programmes, through which they can identify:

- Specific outcomes required in each area of abatement potential, together with milestones and timelines along the way.
- Barriers which have to be overcome and the incentives which will need to be applied.
- Opportunities to streamline and rationalise the range of initiatives and bodies aimed at addressing climate change.
- Action plans that make it clear who is responsible for what.

Only with this disciplined approach to project management are we likely to implement the major initiatives that will be required in the next few years. This in turn depends on decisions being made over the next three years in the following vital areas to create a framework which promotes change:

- Delivering revenue-neutral **fiscal reform** to improve the financial incentives to action for consumers and business. Priorities should include:
  - Measures aimed at existing residential and commercial buildings. Three-quarters of the housing stock which will be used in 2050 has already been built, yet average property in the UK currently falls in bands D-E for energy efficiency and CO_2 ratings. There should be a commitment to identify and agree within two years options to "green" property taxes, such as business rates and council tax, to reward those owners who improve the carbon performance of their property; and to extend the planned exemption of stamp duty for new zero-carbon homes so as to cover all homes according to their carbon efficiency.

We need a new policy framework in which government, business and consumers can work together towards a shared national objective

  - Converting into action the joint statement of intent (agreed in July 2007 with the French government) to propose EU-wide reduced VAT rates for a range of greener products, from cars to white goods, within two years.

  - Identifying and implementing within two years opportunities to reward corporate best practice through favourable tax treatment in return for such measures as corporate reporting on emissions or support given to employees to adopt low carbon working practices.

  - Extending and improving within two years the current enhanced capital allowances (ECA) scheme for business investment in green equipment.

- Radically improving the quality and consistency of **information** available to consumers and businesses. This is an area where business can take a lead and promote benchmarking to drive continuous improvement by, for example:

  - Agreeing and implementing in 2008 a standard for measuring the carbon footprint of products and services by building on the work (which is also looking at other relevant issues, such as how such information is communicated) of leading businesses together with the Carbon Trust and BSI. The Carbon Trust/BSI project involves input from a wide range of companies and a current wave of pilots involving ten leading UK firms.

  - Promoting a standard for corporate reporting for emissions suitable for larger and smaller firms, based on the existing, internationally accepted Greenhouse Gas Protocol. A standard should be agreed and rolled out over the next three years, with a goal to make reporting to this standard mandatory by 2013.

  - Extending the A-G energy efficiency ratings used on selected white goods to include all brown goods such as TVs and radios, building on the Energy Savings Trust's labelling project as a way of developing an EU-wide approach over the next two years.

  - Promoting awareness during 2008 about the need for adaptation, and developing tools to help business understand and manage the risks and opportunities to their business created by climate change. The range of national and regional initiatives aimed at supporting business actions to cut emissions also needs to be streamlined, by following up in 2008 on the pilot advice service for SMEs run by English Rural Development agencies announced in the 2007 Budget.

- Securing EU agreement early in 2008 on the **future form of the ETS in setting an effective carbon price**. A tighter cap is vital, to encourage investment in low carbon technology, but should be done in a way which does not drive industrial production overseas. Major items that must be addressed include:

  - Setting in place a stable, long-term methodology for fixing the ETS cap, including access to credits for non-European projects. A greater role is essential for the European Commission in ensuring that the cap is set rigorously, as long as it takes proper account of different member states' circumstances. Budget periods need to be set several phases in advance.

  - Clarifying the relationship between the ETS objectives and the EU's 2020 targets for renewable energy, biofuels and energy efficiency, so that the central role of the ETS in delivering emissions reduction is reinforced.

Box 11: Task Force initiatives in transport

Ford has announced plans to spend at least £1bn developing a range of global environmental technologies in the UK for its Ford, Jaguar, Land Rover and Volvo brands – one of the largest commitments to the environment by a carmaker in the UK. Ford will introduce a mainstream car at below 120g/km CO_2 in January 2008 with a sub 100g/km Fiesta-size car following in early 2009. Its plants at Dunton and Dagenham together have become the largest development and production entities of clean diesel technology in the UK.

BP has created a new biofuels business and has already announced plans to build a $400m bioethanol plant with Associated British Foods near Hull. It has also announced plans to spend $500m over the next 10 years to establish a dedicated Energy Biosciences Institute (EBI) that will develop innovative new biotech solutions to energy challenges.

Shell is also working in this area and has joint ventures in "later generation" biofuels that produce energy from crop waste rather than the crop itself. The joint ventures cover bioethanol and biodiesel. Shell has also developed a set of sustainability standards for biofuels sourcing. **BA** is sponsoring research into alternative fuels.

Rolls-Royce is leading an industry and government research programme, the Environmentally Friendly Engine, to develop aerospace technologies. The programme was launched in 2006 and is scheduled to run until the end of 2010. Rolls-Royce itself is investing approximately £700m per year on R&D – with a major emphasis on reducing environmental impact of its products – and through ACARE (the Advisory Council for Aeronautics Research in Europe) is working with the aerospace industry towards a 50 per cent reduction in CO_2 emissions per passenger kilometre for new aircraft by 2020, in addition to an 80 per cent reduction in oxides of nitrogen and 50 per cent in noise emissions (from a 2000 baseline).

BA has pioneered operational practices, such as continuous descent approaches, which reduce fuel burn and therefore emissions. Since 1990, the airline has improved fleet efficiency by 28 per cent and it now has a target for further fuel efficiency of 25 per cent by 2030 compared with 2005.

Corus is implementing a £153m investment at its plant in the Netherlands to install new capacity for steel products in the automotive sector, including Advanced High Strength Steels for use in future generations of energy-efficient vehicles. Corus has also formed a 7-year partnership with TDG to develop a best-in-class road transport operation that will save over a million miles transportation every year and cut fuel consumption by over half a million litres.

Tesco has set itself a target to reduce the amount of CO_2 emitted in its distribution network to deliver a case of goods by 50 per cent. It is running its distribution fleet on a 50:50 biodiesel blend and has improved the efficiency of its network and vehicles. It also has a purpose-built "green" train which saves an estimated 4.5m road miles.

BA was the first airline to enable its customers to offset their flight emissions, and is developing ways of making it more convenient for customers to do so. **Aviva** is working with subsidiaries to offset emissions as part of motor insurance packages. Its subsidiary, UK Norwich Union, has a discounted insurance scheme with Ford for its bioethanol flexi fuel vehicle.

Shell has launched the Shell Drivers' Club, a loyalty scheme for petrol customers in the UK, designed to raise awareness of climate change and to encourage customers to reduce their carbon footprints. The club provides participants the opportunity to use loyalty points to offset their carbon emissions.

Three-quarters of the housing stock which will be used in 2050 has already been built

– Moving carefully towards the greater use of auctioning for ETS allocations. This should be approached on a sector-by-sector basis, with the proportion of auctioning linked to the ability of each sector to pass on the cost of carbon to its customers, and where the revenue raised is recycled to support a range of low carbon business initiatives. Where there is little or no ability to pass through higher carbon costs, free allocation of allowances should be considered, based on sector-wide benchmarks of good practice and done in a way compliant with EU and international rules on state aid and subsidies. In sectors like iron and steel, this could be a first step towards a global sectoral agreement to curb emissions.

– Exploring the possibility of requiring importers of goods from outside the EU to buy carbon allowances according to the carbon intensity of the products they are bringing in. The idea would be to create a level playing field with industries operating within the EU under the ETS, but we recognise the very significant legal and practical constraints in doing this. There is a considerable risk that this approach could encourage protectionist tendencies, so it should only be pursued if it can be done in a way that is compliant with the World Trade Organisation rules and does not lead to retaliatory trade action.

– Incorporating aviation into the EU ETS to take effect from 2011, as a first step towards a global trading system for aviation.

– Ensuring that the EU ETS is able to link with other emerging cap and trade schemes being developed around the world, and working towards international agreement by the end of 2009 on a successor to the Kyoto Protocol.

– Reaching agreement with business in 2008 on the design of related UK policy instruments, such as the Carbon Reduction Commitment (CRC) and extension of the existing Climate Change Agreements (CCAs).

• Delivering a more effective approach to **R&D**, with a particular focus in supporting demonstration and early deployment of emerging technologies, where business and government work closely together to:

– Reprioritise funding to put much greater emphasis on climate change technologies that are no more than 10 years away from the market place, combined with more coherent support programmes and the phasing of expenditure in order to pull through emerging technologies from concept to commercial deployment.

– Increase funding for long-term innovation, through public private partnerships, both for R&D and to support the demonstration and deployment of technologies in low carbon areas. The aim should be to achieve, at the very least, public funding equal to the EU average (0.17 per cent of GDP) within three years, focusing on families of key technologies rather than attempting to pick specific winners, and making use of revenue from EU ETS auctions to help achieve this.

– Make the best use of the government's own purchasing power to stimulate demand for emerging technologies. Delivering the targets to cut emissions from government offices and vehicles in the next three years under its Sustainable Procurement Plan (and extending them to other parts of the public sector, such as local government) offers important ways of doing this.

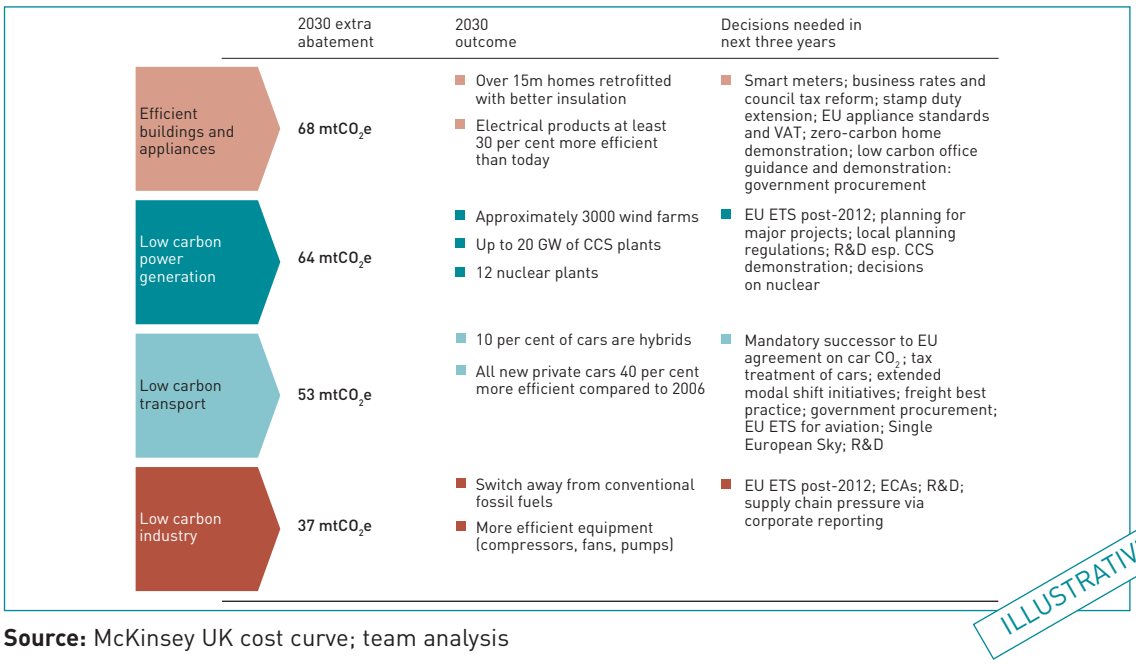
Delivering infrastructure and technologies in areas such as power or transport will depend on world class management of funding, expertise and manpower, both within the UK and along global supply chains

- Driving through **reform of the planning system**, by:
  - Enacting the Planning Bill in 2008 and agreeing to streamline the approval process covering major infrastructure projects, such as power generation. Priorities include ensuring the proposals involve local communities in a timely way, and work effectively alongside the devolved responsibilities of the Scottish and Welsh authorities.
  - Encouraging changes to the planning system at a local level so as to support green technology and remove impediments to such systems as micro-generation or local combined heat and power. Publication before the end of 2007 of a Planning Policy Statement on climate change should be followed by action to ensure a clear presumption on the ground in favour of development for green technology, with the burden of proof switching from the applicant to those opposing such projects.
- Reaching decisions on important items of **regulation** in the main areas of abatement potential. For example:
  - In power, reaching a decision on the role of nuclear power in low carbon economy by the end of 2007, with the aim to implement all other associated regulatory issues by 2010, and agreeing in early 2008 the charging regime for offshore transmission to go live in 2009.
  - In road transport, pushing for early agreement in 2008 on a mandatory EU target for new car CO_2 emissions to replace the current voluntary arrangements. This should be based on an integrated approach, allowing use of engine, non-engine and fuel technologies to achieve the target over a timescale that is challenging yet achievable for the automotive and fuel industries. A recent report by the Commission for Integrated Transport showed that complementing this approach with a package of fiscal incentives, freight best practice and extended programmes to encourage use of alternatives to the car could cut transport emissions in 2020 by 14 per cent compared with 1990 levels.
  - In aviation, reaching agreement within three years on implementation of the Single European Sky proposals for European air traffic management, which could reduce aviation fuel consumption by at least 12 per cent.
  - In buildings, working with the industry to agree by early 2008 a mandated schedule which would result in smart energy meters being installed in all households by 2013. Agreement is also needed in 2008 on guidance for low carbon commercial buildings. The UK should also lead the debate in the EU to secure speedy resolution of energy efficiency standards for brown goods to match the regime which already exists for white goods.

The specific priorities set out above are intended to help deliver the essential conditions for implementation in each of the main abatement areas. Figure 12 sets out which priorities are most relevant to which area. In each case, a mix of policy decisions is necessary to promote emissions reductions beyond that already expected under existing programmes, but the balance of measures will differ.

In some areas, fiscal reform or the role of a carbon price may have a particularly significant role to play; in others the systems of product standards and regulations may be more important. For all, a significant increase in R&D activity (particularly in demonstration of emerging technologies) is vital.

Figure 12: Timelines to implement policies are tough and decisions need to be made in the next three years



Source: McKinsey UK cost curve; team analysis

Task Force commitments

As business leaders, we believe it is essential that the private sector should work together with government to ensure these measures are implemented. If carbon is indeed to become the new currency, then business must be at the heart of a radical shift in the way the economy works.

We readily accept our responsibility to go further in addressing our own impact on climate change and in working with others. With a global carbon footprint from our operations of approximately 370 $mtCO_2e$, or roughly 1% of global emissions, we are well positioned to effect a significant change by engaging with our suppliers, customers and staff.

Our first priority is to ensure that we deliver our existing corporate commitments to address climate change. We have already taken significant steps to tackle emissions and as illustrated in Box 12 on page 40 are committed to further improvements.

But we know that the scale of emissions cuts required means that more will need to be done by the whole of our society. We therefore commit over the next three years to a series of further initiatives through which we will work with consumers, other businesses and government to make a positive impact in the areas where additional effort is most needed to cut emissions.

We will develop new products and services that will enable all households in the UK to cut their emissions in half by 2020.

- Task Force companies provide a wide range of products and services to millions of customers. We will work with others to draw up an action plan and milestones which build on existing initiatives to reduce emissions in the three key areas which consumers can directly influence – homes, appliances and personal travel. One initiative, led by Barclays, will develop green finance products: a personal loan is at an advanced stage of development and will incentivise householders to improve the energy efficiency of their homes. Other products will follow.

We will work with our 2m employees to help them reduce their greenhouse gas emissions at work and at home.

- Task Force members have already undertaken a number of initiatives to help their employees cut emissions at home as well as at work. We will encourage best practice in this area, and we will extend these ideas to other companies. Our aim is to begin by identifying and promoting action to save 1 $mtCO_2e$ within three years. We will co-ordinate this work with our efforts to help all households cut their emissions in half by 2020.

We will promote effective reporting procedures that set the benchmark for reporting carbon emissions.*

- We will work with others, including the Carbon Trust, to promote a universal standard for reporting business emissions that could be adopted by all companies above a certain size, based on the existing, internationally accepted Greenhouse Gas Protocol. We will develop an SME-friendly version of this standard as part of a free SME toolkit for measuring and managing carbon and which we will adopt as a recognised universal standard. As well as developing specific low carbon products and services, we will also support the work of the Carbon Trust,

* This specific commitment excludes the London Stock Exchange in relation to the companies on its markets.

As business leaders, we believe it is essential that the private sector should work together with government to ensure these measures are implemented

BSI and businesses actively involved in developing a standard for measuring the carbon impact of goods and services, and encourage best practice in communicating this information to consumers.

We will work with government to co-ordinate and manage the implementation of emission savings projects and to improve the effectiveness of spending on research, development and deployment of new technologies.

- We will work with government departments to bring the public and private sectors together to drive delivery of emission reduction measures and which can support the work of the proposed Climate Change Committee. We will aim to improve the effectiveness of measures to promote R&D through Task Force members' work with the Energy Research Partnership, Energy Technologies Institute and Technology Strategy Board and the Carbon Trust; and by holding a green "Great Exhibition" to promote businesses developing low carbon technologies. We will also promote the case for fiscal reform to incentivise a low carbon economy, for example, through the UK Green Fiscal Commission, which includes representatives from the three main political parties and the CBI.

We will audit and cut emissions from our company car fleets and buildings.

- We will first measure the current carbon performance of our company car fleets and buildings and then set a goal to reduce emissions from these sources. Our ambition is to do better than the government's own targets as set out in its Sustainable Procurement Action Plan. The government's targets are to cut office emissions (against a 1990-2000 baseline) by 12.5 per cent by 2010-11 and by 30 per cent by 2020; and to cut emissions from road vehicles used on government administrative operations by 15 per cent by 2010-11 relative to 2005-6 levels. We will work with the Carbon Trust and others to implement the measures needed to meet our targets.

We will provide resources over three years to create a new Climate Change Unit to enhance the CBI's work on climate change in the UK and internationally.

- The new unit will work on these commitments, overseen by Task Force members and reporting annually on progress. One of its main priorities will be to engage actively the CBI's wider membership and others in support of the above commitments, sharing best practice and identifying opportunities for growth. Increased resources will also allow the CBI to give a greater climate change focus to its existing policy work in areas such as transport, innovation and skills; to work more effectively with other organisations to promote better business awareness of adaptation issues; and to build alliances with business organisations in other major economies, in order to support and influence international negotiations over the next two years aimed at delivering a successor to the Kyoto Protocol.

Box 12: Individual Task Force commitments

Member	Commitment
Aviva	Aviva plans to reduce its carbon footprint by a further 10 per cent by the end of 2008 based on 2006 figures.
Barclays	Plans to reduce CO_2 emissions by 20 per cent against a 2005 baseline.
Bio Group	Bio Group plans to reduce its emissions by 25 per cent within three years compared with 2007.
British Airways	BA has set a target for a further fuel efficiency improvement of 25 per cent by 2030, compared with 2005.
BP	BP has set a target to improve the energy efficiency of operations by 10-15 per cent by 2012, against a 2001 baseline.
BT	Target is to reduce CO_2 emissions in the UK by 80 per cent (against 1996 baseline) by 2016.
Corus	Through various initiatives, Corus expects that the CO_2 intensity of its products (expressed as CO_2/tonne steel) will have reduced by 20 per cent by 2020 compared to 1990.
Ford	Global commitment to build on a 16 per cent reduction 2000-07 by increasing CO_2 efficiency per production unit by 1-2 per cent p.a.
INEOS	By the end of 2007, it is forecast that the Chlor/Enterprises part of the business will have reduced its Specific Energy Consumption by 17 per cent, and this is expected to increase to 20 per cent by 2010.
McKinsey	Combined measures over the past two years mean that McKinsey's London office is on track to reduce its carbon footprint by 30 per cent by the end of 2008.
Rolls-Royce	The target for 2009 is to further reduce energy consumed (normalised by financial turnover) by 10 per cent thus reducing its carbon footprint globally.
RWE npower	To reduce the amount of CO_2 it emits per unit of power generated in the UK by 50 per cent by 2015 compared to 1990 levels.
Shell	Current target for greenhouse gas emissions is to be 5 per cent below 1990 levels in 2010 (despite business growth and increases in the energy intensity of producing oil and natural gas).
Siemens	Global target to increase energy efficiency by 20 per cent from 2006 to 2011.
Sun Microsystems	Sun has committed to the US Environmental Protection Agency to lower its greenhouse gas emissions with a 20 per cent CO_2 reduction by 2012 and a stretch goal of 2008.
Tesco	By 2020, Tesco intends to have halved the carbon footprint of its existing business from a baseline of 2006. It has also set a target that new stores built between now and then will – on average – be half as carbon intensive.

British business will do what it takes to build a competitive low carbon economy in the UK

Conclusion

British business will do what it takes to build a competitive low carbon economy in the UK. This has to be a shared national priority, involving constructive partnerships between government, consumers and businesses at a national and international level.

This report is a call for action. It is clear that decisions taken in the next few years will shape our society for generations to come. We need clear signposts for the road ahead, and measurable outcomes along the way. The risk is that the national effort will be dissipated in a welter of sometimes conflicting government and business initiatives. But the great opportunity is to build a leadership position both in framing the international debate, and in developing new products and services for the low carbon economy of tomorrow.

For the Task Force, this report marks the beginning of the next stage of the journey and its support for the CBI's work on climate change. Like other businesses, its members have already made big steps to increase their energy efficiency and to lower the carbon content of their energy sources. They are now committing both to going further down this pathway, and to broadening the impact of their efforts across society as a whole. They want results, and will reconvene regularly in the future both to report on their own progress, and to see what else needs to be done for the UK to meet its goals. For them, a successful outcome will be a greener and more prosperous planet.

The CBI will now be seeking to engage all its members as well as the international business community and other stakeholders in this project. Its mission will involve a mix of advocacy and persuasion aimed at national and international audiences. And it will also seek to share best practice among companies, and to celebrate the successes of British-based businesses in a changing economic environment.

The conclusion of this report is that climate change is everyone's business and provided our society acts together in a timely fashion to adapt and to cut emissions, we will not have to face painful choices between economic development on the one hand and climate change on the other. As a major developed economy, the UK has a significant role to play in this international challenge.

And within the UK, business has both the responsibility and the ambition to be an important part of the solution.

Appendix 1: UK Cost Curve

The Task Force commissioned McKinsey to undertake the first comprehensive study of its kind for the UK. This appendix summarises the methodology used to complete the study: a more detailed description can be found on www.cbi.org.uk.

The analysis took as its starting point a previous McKinsey study on global greenhouse gas emissions. It then tailored that work to the UK, using a methodology developed over the past two years with the assistance of leading institutions and experts.

A research team from McKinsey constructed a baseline forecast for UK emissions to 2030, drawing on a number of government and public sources. Working with Task Force members and other leading companies, the team then estimated the potential benefits and cost for over 120 options for greenhouse gas abatement. These were represented in graphical form, illustrating the cumulative potential for emission reduction on the horizontal axis, and the cost per tonne of emissions avoided on the vertical axis.

We do not expect this study to be the final word on how best to cut UK greenhouse gas emissions. However, the level of detail obtained by this study is higher than anything produced before in the UK, and offers some important insights about the task that faces us.

- While considerable improvements have been made, the current UK targets for 2020 and 2050 will not be met without significant additional effort. All abatement options must be considered if we are to meet the targets.

- Meeting the 2020 target will be extremely challenging, requiring nothing less than a full implementation of all the options. By 2030, more technologies will have come on stream and old assets will have retired, increasing the likelihood of achieving the 2050 target. This assumes an underlying growth rate for GDP of between 2-3% p.a. between now and 2030.

- All sectors of the UK economy can contribute to the reductions, which will come in roughly equal measure from improvements in buildings, transport, power generation and industrial processes.

- While we believe that implementing all the abatement options will not require a reduction in the consumption of goods and services, it will require a significant change in the way we consume.

- Meeting the targets implies a cost, which will need to be shared across business, government and consumers. The cost will be highest in the early years: we estimate that in 2020 it could be as high as €90 per tonne for every tonne of greenhouse gases emitted. As 2030 approaches, all the technologies needed to reduce emissions will become commercially viable, more options will be available, and we expect this marginal cost to decrease to €40 per tonne of emitted greenhouse gas provided all initiatives are implemented in full. Furthermore, 60 per cent of these initiatives will increase energy efficiency and half will constitute a net financial benefit.

- Early action is critical. Many of the options that can deliver abatements over the next 20 years require the UK to start acting now. In particular, potentially difficult choices will have to be made on issues such as nuclear power, biofuels, carbon capture and storage, and on insulating the existing building stock.

The UK has committed to a reduction in CO_2 emissions of 26-32 per cent by 2020 and of 60 per cent by 2050 from 1990 levels. Meeting the 2050 target would be approximately equivalent to achieving Japan's energy intensity (which uses 25 per cent less energy for each £ of GDP produced) while also achieving France's carbon intensity of energy used, which is approximately 30 per cent lower than the UK through a substantially different fuel mix.

Our analysis applies the government's targets to all greenhouse gases (not just CO_2) and includes international transport. It also incorporates a baseline forecast of emissions to take account of emissions abatement which is expected from planned programmes. This baseline already includes the 15 per cent improvement beyond today's technology by 2020 and a 25 per cent improvement by 2050.

The cost curve can be used to verify the potential and marginal cost of action over and above the baseline to meet these targets. To meet the 2020 targets, additional abatements of over 130 $mtCO_2e$ are needed. Assuming a 100 per cent implementation rate, 90-95 per cent of the target could be reached at a marginal price of €60-€90/tCO_2e (figure 13). However, the likelihood of capturing all of that potential depends on implementation. If we assume that only 80 per cent of the potential is achieved on average, additional abatements would need to be found to achieve the target.

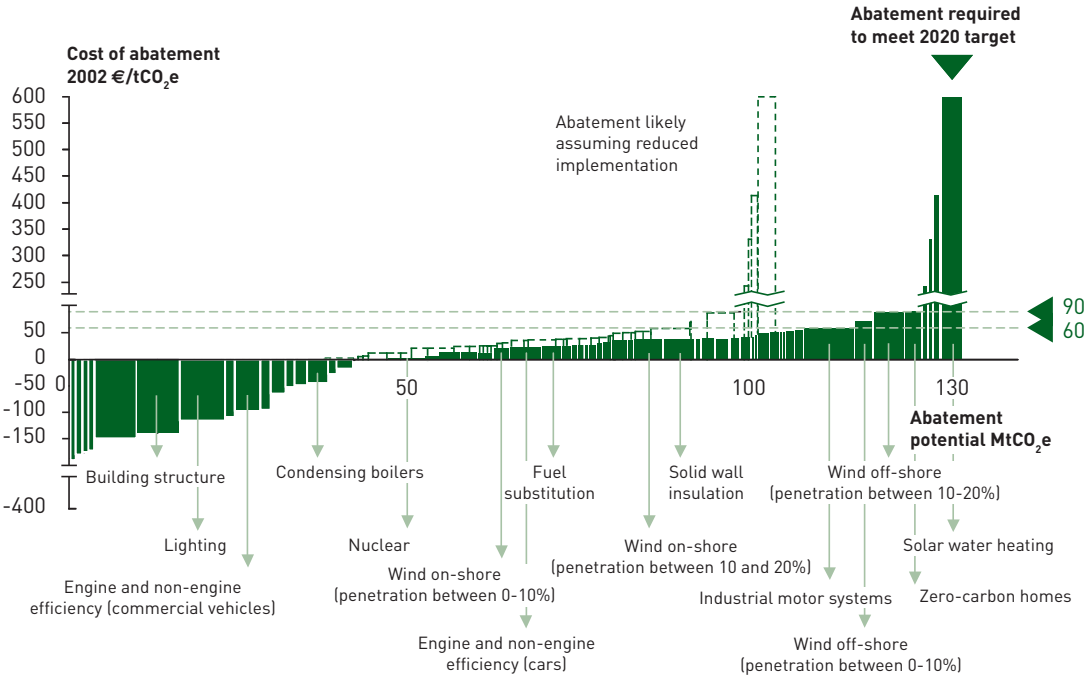
By 2030, the additional abatements of 230 $mtCO_2e$ are necessary for the UK to be on a linear trajectory towards the 2050 target. The full cost curve implies that achieving these abatements is possible and the implied marginal cost would be approximately €40/tonne (figure 14). A reduced implementation scenario would imply a significantly higher price of carbon, but would still allow for meeting the target.

By the same date, full implementation of all measures will have reduced emissions by 25 per cent compared to baseline and by almost 40 per cent compared to 1990 levels. This means that, for example, the carbon intensity of electricity production will have to decrease by over 66 per cent, vehicle efficiency will have to increase by over 60 per cent, and buildings will have to be almost 40 per cent more efficient.

To put these numbers in perspective, historical emission reductions per unit of GDP have been just 2.2 per cent per year, while full implementation to meet the targets implies a reduction of 3.5 per cent per year. This can be disaggregated into two strands: a reduction in energy use (which in terms of energy per GDP will decrease by 2.7 per cent per year compared to a 2 per cent reduction in the baseline) and a reduction in carbon intensity (which will decrease at the rate of 0.8 per cent per year against a baseline of 0.2 per cent per year). The scale of the effort is particularly clear when considering electricity consumption per capita, which under baseline would continue to *increase* at a rate of 0.4 per cent per year, and that with additional abatements and under full implementation assumptions will have to *fall* by 0.6 per cent per year.

To calculate a credible estimate of the total potential cost of implementing all abatement levers in a given year, it is not sufficient to add up the costs along the cost curve. The reason is that the cost curve represents only the technological cost and does not take into consideration transactional costs (e.g. the management time needed to implement an initiative, the costs involved in raising awareness, the costs in overcoming high discount rates, etc.) which may add to the overall cost of implementation.

Figure 13: The 2020 UK cost curve for additional greenhouse gas reduction measures



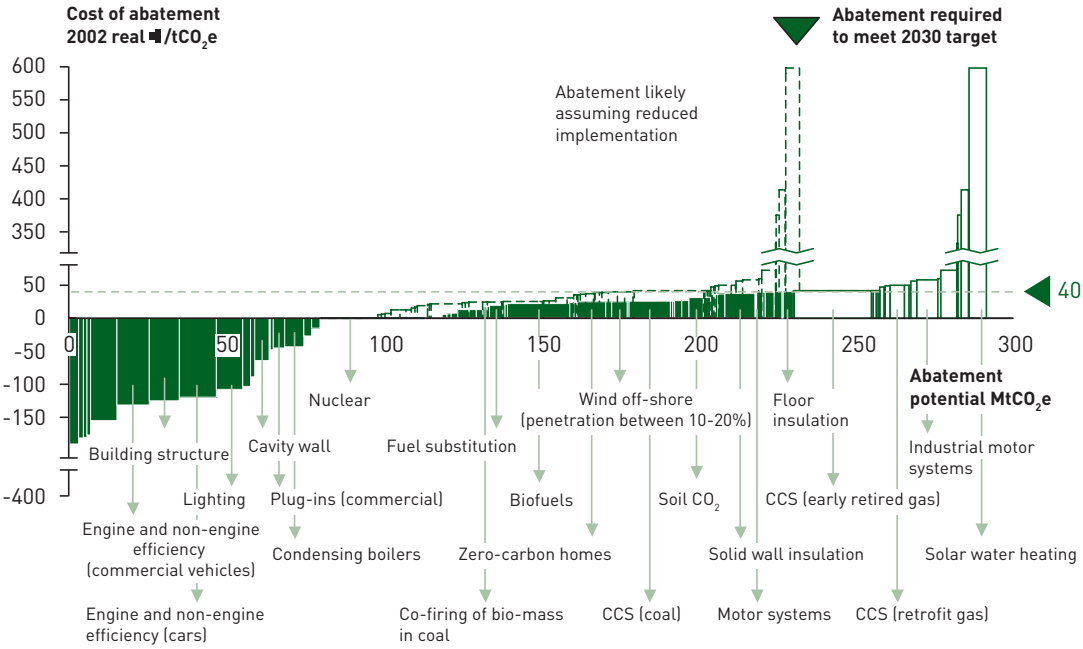
Source: McKinsey UK cost curve; team analysis

The cost is plotted on the vertical axis, and is calculated as additional to the baseline cost. It is the annual additional operating cost (including depreciation of capital expenses) less potential cost savings (for example, from reduced energy consumption) divided by the amount of emissions avoided. Transitional costs for implementing the initiative and opportunity costs associated with foregone alternative investments are not included.

The abatement potential is shown on the horizontal axis and is estimated as a "technical" potential. The volumes should not be seen as forecasts, but rather as estimates of what is practically feasible in the timeframe chosen for the cost curve. Measures are arranged in order of cost, with the cheapest on the left, and the most expensive on the right.

The bars shown as dashed lines represent reduced implementation assumptions. Meeting the 2020 target is going to be very challenging and will only be possible if all additional abatement initiatives are adopted. Around 90 to 95 per cent of the measures cost less than €60-€0/tCO_2e (shown by the dotted horizontal line).

Figure 14: The 2030 UK cost curve for additional greenhouse gas reduction measures



Source: McKinsey UK cost curve; team analysis

The bars shown as dashed lines represent reduced implementation assumptions. Meeting the implied 2030 target to be on track to 2050 is possible both in the full and reduced implementation scenarios, although with very different marginal costs. In full implementation, initiatives up to €40/tCO_2e are needed.

Despite these difficulties, an upper estimate of cost can be made by assuming that all hidden costs will amount to no more than the net benefit resulting from implementing the initiative and that for all cost-positive abatement initiatives there are no additional implementation costs beyond those captured in the cost curve. For each abatement initiative, we can therefore apply the 2020 cost to the portion of abatement installed by 2020 and the 2030 cost to the portion of abatement installed between 2020 and 2030. The total cost of implementing the full abatement in 2030 is the sum of all costs. This provides an upper bound on the cost of implementation of approximately €3.6bn which is approximately equivalent to £2.5bn, or assuming 25m households, approximately £100 per household.

The 2007 Energy White Paper included a cost abatement curve for 2020. A direct comparison between that analysis and this one is not straightforward due to the difference in assumptions. For example, the White Paper cost curve considers a mixture of technologies (e.g. insulation, wind power) *and* policies (e.g. extension of renewable fuel transport obligation, implementation of smart meters) that imply the adoption of technologies. The White Paper also shows a lower level of detail, so that individual items on the White Paper cost curve (such as "standard insulation") represent multiple measures on the cost curve shown in this analysis, with multiple potentials and costs.

But some comparisons are possible. For example, the White Paper assumes an additional cost of nuclear of €2/tCO_2e, close to our assumption for 2020 and it assumes a cost for on-shore wind of €77/tCO_2e, close to our assumption of €62/tCO_2e.

On the estimates of potential abatement delivered by specific technologies, the White Paper assumes a baseline decarbonisation of 14 per cent by 2020, similar to that implied by this analysis of 15 per cent. The spread of opportunities across sectors is also approximately similar: the White Paper assumes that energy efficiency (for example, in buildings) account for 32 per cent of additional abatements, compared to our 36 per cent; transport including domestic aviation is 17 per cent compared to our 12 per cent; ETS covered sectors would contribute approximately 47 per cent compared to our 50 per cent.

However, there are some key differences that make our analysis less optimistic with respect to the 2020 targets than the White Paper appears to be. For example:

- We have assumed that CCS will only become commercially available after 2020. It is critical that the government accelerates demonstration projects to ensure the technology is commercially available as soon as possible.

- Unlike the White Paper, we do not assume that wind potential will be fully exploited to meet the renewable obligation targets as a matter of baseline. We believe this is an additional abatement that will require additional efforts, including a reform of the planning system and overcoming high upfront costs.

- Although we have included a number of gateways towards zero-carbon homes, we do not currently believe that zero-carbon homes should be included in a baseline scenario, and instead will require additional effort.

- The single biggest additional measure in terms of impact envisaged by the White Paper is a successor to EU ETS. However, it should be noted that the marginal price implied by our cost curve to meet the 2020 target is high compared to historical and currently projected future prices.

Appendix 2: Business and adaptation

The CBI commissioned the Met Office to assess what adaptation to climate change might mean for business. A workshop was also held in July 2007, and a paper with the conclusions can be found on www.cbi.org.uk. These include:

- Weather damage in the UK is likely to double in a normal year between 2040 and 2060. Extreme years could push damage up to the order of £10bn, with coastal flooding potentially responsible for the biggest cost. This compares with the estimated cost of insurance claims of £3bn arising in 2007 from the summer floods in England.

- Perceived vulnerability to climate change varies significantly from one business sector to another. Some organisations are doing more than others to develop their knowledge of the risks and opportunities, and in planning how to manage them (see also p.22 in the main report about business awareness of risks and opportunities).

- Incremental change, as well as increasing extremes, in weather – for example, in temperature, rainfall and wind – bring different but no less significant challenges to businesses. Different sectors will need to understand more about the important "tipping points" for their operations or products. Examples include the need for the power sector to respond to weather-related surges of demand for electricity, or for the construction industry to understand the impact of a sustained rise in average temperatures on materials and product design.

- The geographical incidence of climate change on the UK economy will also vary. In some cases impacts will be local, such as the summer 2006 heatwave which led to a London power "brownout". In other cases, they may be international and affect global supply chains: two of the UK's top trading partners, France and Spain, were among countries significantly affected by heatwaves in the summer of 2003.

- The need for business to adapt to climate change will lead to new demands for meteorological information, an area where the UK is a world leader. Different businesses will need different types of information. While the majority may look no more than five years ahead at most, some sectors, such as utilities and pension funds, also look decades ahead, while others, such as agriculture, will need accurate daily information.

Task Force Members

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BARCLAYS	Mr Marcus Agius, Chairman, Barclays Plc
McKinsey&Company	Mr Dominic Casserley, Managing Partner – UK & Ireland, McKinsey & Company Inc UK
bp	Mr Iain Conn, Group Managing Director and Chief Executive, Refining & Marketing, BP Plc
INEOS	Mr Tom Crotty, Chairman, Ineos ChlorVinyls
Ford	Mr Roelant de Waard, Chairman & Managing Director, The Ford Motor Co Ltd
npower RWE Group	Mr Andrew Duff, Chief Executive Officer, RWE npower Plc
London STOCK EXCHANGE	Mrs Clara Furse, Chief Executive, London Stock Exchange
Sun	Ms Kim Jones, President & Managing Director UK & Ireland, Sun Microsystems Ltd
CBI THE VOICE OF BUSINESS	Mr Richard Lambert, Director-General, CBI
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AVIVA	Mr Andrew Moss, Group Chief Executive, Aviva Plc
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Rolls-Royce	Sir John Rose, Chief Executive, Rolls-Royce Plc
Bio	Mr Steve Sharratt, Chief Executive, Bio Group Limited
	Mr James Smith, Chairman, Shell UK Ltd, Royal Dutch Shell Plc
corus	Mr Philippe Varin, Chief Executive, Corus
BRITISH AIRWAYS	Mr Willie Walsh, Chief Executive, British Airways Plc
SIEMENS	Mr Alan Wood, Chairman, Siemens UK

Glossary

Abatement – Refers to the reduction of greenhouse gases in the atmosphere and is most commonly used to describe ways of saving carbon – abatement measures or abatement technologies (also see Mitigation).

Adaptation – Taking action to reduce the consequences of a changing climate such as building flood barriers or assessing the risks of a changing climate to business operations.

Allocation methodologies – The method by which the overall cap on emissions set under a trading scheme is shared among participants within the scheme. A number of possible methodologies are currently being considered by the European Commission (also see European Union Emissions Trading Scheme).

Biofuel – A fuel derived from biomass and considered as a means of reducing GHG emissions by providing an alternative to conventional fossil fuels. Biofuels can be made from rape seed (biodiesel) and maize (bioethanol) although research has indicated that biofuels from grasses and woody coppice species have more favourable climate impacts.

Business rates – A business tax on the occupation of non-domestic property.

Carbon capture and storage (CCS) – A long-term alternative to emitting CO_2 from power generation or industrial processes into the atmosphere, where the CO_2 is captured at its source and stored, most commonly underground.

Carbon dioxide (CO_2) – The principal gaseous product from the combustion of natural gas, oil and coal. CO_2 exists naturally in the atmosphere, is a greenhouse gas, and its concentration has been rising over the last century (also see Greenhouse gas).

Carbon Disclosure Project – This is an independent organisation which works with shareholders and corporations to disclose the GHG emissions of the major corporations of the world. In 2007, it published the emissions data for 2,400 of the world's largest corporations, accounting for 26% of global anthropogenic emissions. The CDP represents major institutional investors, with a combined $41 trillion under management.

Carbon footprint – A representation of the amount of greenhouse gas emissions linked to a particular activity or set of activities. It is generally referred to as a measure of the amount of carbon emitted; in the case of a business, as part of its everyday operations; in the case of an individual or household, as part of their daily lives; or in the case of a product or service, as a result of its production, use and final disposal.

Carbon intensive firms – Businesses that emit a large amount of carbon in their production processes such as aluminium, cement or steel.

Carbon pricing – Refers to the action of putting a price on carbon. There are several possibilities to establish a carbon price. Options include the adoption of a carbon tax or a cap-and-trade scheme.

Combined heat and power (CHP) – A process or technology that uses waste heat from power generation to generate simultaneously both electricity and useful heat.

DEFRA – Department of the Environment, Food and Rural Affairs.

European Union Emissions Trading Scheme (EU ETS) – In January 2005 the European Union Greenhouse Gas Emission Trading Scheme began operation as the largest multi-country, multi-sector GHG emission trading scheme worldwide. It covers over 11,500 energy-intensive installations across the EU, which represent close to half of Europe's emissions of CO_2. The aim of the EU ETS is to help EU member states comply with their commitments to reduce emissions under the Kyoto Protocol.

Fuel substitution – The substitution of fossil fuels for renewable energy, waste or biomass.

Fuel cell – An electrochemical conversion device that produces electricity efficiently from external supplies of hydrogen (fuel) and air (oxidant). Efficiency can be enhanced when fuel cell technologies are combined with waste heat recovery.

Greenhouse gas (GHG) – A gas in the earth's atmosphere that absorbs infrared radiation, thus allowing the atmosphere to retain heat. Such gases occur through both natural and human influenced processes. Primary GHGs, aside from water vapour include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6). Gases such as halogenated carbon compounds (CFC and HCFC) also require ongoing attention in both developed and developing countries.

GHG Protocol – The Greenhouse Gas Protocol (GHG Protocol) is a widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions. It consists of three types of emissions – scope 1 or direction emissions from sources controlled or owned by the company (such as heating or company vehicles), scope 2 or indirect emissions from the purchase of electricity through the national grid and scope 3 emissions from supply chains such as transport by third parties or the emissions generated in the production of products before they reach the company.

Gross Domestic Product (GDP) – It is the total market value of all final goods and services produced in a country in a given year. It is equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports. It is the most commonly used measure of the size of the economy.

Intergovernmental Panel on Climate Change (IPCC) – Established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation.The IPCC is led by government scientists, but also involves several hundred academic scientists and researchers. It has published four major reports reviewing the latest climate science, as well as more specialized reports. For the IPCC's recently launched Fourth Assessment Report people from over 130 countries contributed over 6 years, including more than 2,500 scientific expert reviewers, 850 contributing authors and 450 lead authors.

Kyoto Protocol – A UNFCCC international agreement that sets binding targets for the reduction of GHG emissions by industrialised countries (known as Annex 1 countries). It was agreed on 11th December 1997 at the 3rd Conference of the Parties (COP 3) to the treaty when they met in Kyoto, and entered into force on 16th February 2005. As of June 2007, 172 parties had ratified the protocol.

Market instruments – Carbon trading, taxes, subsidies and tax breaks are all examples of market based instruments that aim to encourage cuts in emissions through changes in behaviour or adoption of greener products and services.

Mitigation – The reduction of greenhouse gases in the atmosphere (also see Abatement).

Non-CO_2 gas emissions – Gases other than CO_2 such as nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6) (also see Greenhouse Gas).

Real-time displays – An electronic meter that measures the amount of energy consumed and the cost. The government is proposing that from May 2008, every newly-fitted electricity meter will come with a free tool showing energy consumption and cost. Real-time displays are less sophisticated than smart meters (also see smart meters).

Research and development (R&D) – The stages new technologies have to run through before they can be commercialised.

Single European Sky – A proposal by the European Commissions to create a single European air space by harmonising air traffic management across the 27 members states. The aim is to use more efficient air traffic management that is more closely based on actual flight patterns, rather than the present system which is largely based on national boundaries.

Smart meters – An electronic meter that measures the amount of electricity being used in a building. Smart meters are able to transmit this information to energy suppliers, avoiding the need for house calls to read meters and providing more accurate bills and offering scope for better management of the energy supplied and used by customers. Smart meters can compare use of electricity with the previous day, month or year. It is hoped that in the future smart meters will be able to compare energy prices throughout the day and switch on/off electricity systems according to need and price to reduce wasted energy (also see Real-time displays).

Stern Review – A review commissioned by the British Government to investigate costs of climate change to the global economy led by Sir Nicholas Stern. The review culminated in a report, The Economics of Climate Change, which was published in October 2006 to international acclaim.

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