

# DECC science and innovation strategy 2012

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# DECC Science and Innovation Strategy 2012

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# Section 1 - Introduction

The Department of Energy and Climate Change (DECC) leads the UK Government's efforts to counter the risks of dangerous climate change, and of a shortfall in the supply of safe, affordable energy. These two challenges need to be considered jointly as approximately eighty percent of UK greenhouse gas emissions arise from energy supply and consumption. In the medium term, DECC must address three important, related issues. Firstly, the UK is expecting to import 50% of its oil and gas by 2020, compared with just 20% of oil and 40% of gas today, at a time of rapidly rising demand from emerging economies. Secondly, a quarter of electricity generating capacity is set to close over the next decade. Finally, we need to deploy low-carbon technologies in a way allows us to largely decarbonise the energy sector by 2050, a necessity if we are to meet the requirements of the 2008 Climate Change Act.

DECC's vision for 2050 is for the UK to have made a safe and secure transition to low-carbon electricity, low-carbon homes and buildings, and low-carbon transport and industry, all at least cost to the UK's economy and in support of a global transition to a low-carbon future. We aim to achieve national and international action towards this goal by mobilising investment in low-carbon infrastructure, by setting an appropriate framework of regulation, by providing incentives and information, and by building a broad coalition for change.

In order to deliver this vision, the Department has committed to:

- save energy with the Green Deal and support vulnerable customers;
  - Reduce energy use by households, businesses and the public sector, and help to protect the fuel poor
- deliver secure energy on the way to a low-carbon energy future;
  - Reform the energy market to ensure that the UK has a diverse, safe, secure and affordable energy system and incentivise low-carbon investment and deployment
- drive ambitious action on climate change at home and abroad;
  - Work for international action to tackle climate change, and work with other government departments to ensure that we meet UK carbon budgets efficiently and effectively
- manage our energy legacy responsibly and cost-effectively.
  - Ensure public safety and value for money in the way we manage our nuclear, coal and other energy liabilities

To meet these commitments, DECC must design and deliver policy that is underpinned by high quality scientific and technical evidence and analysis. The objectives set out here have been used to structure this strategy, to demonstrate clearly how the work we do on science and innovation underpins DECC's work.

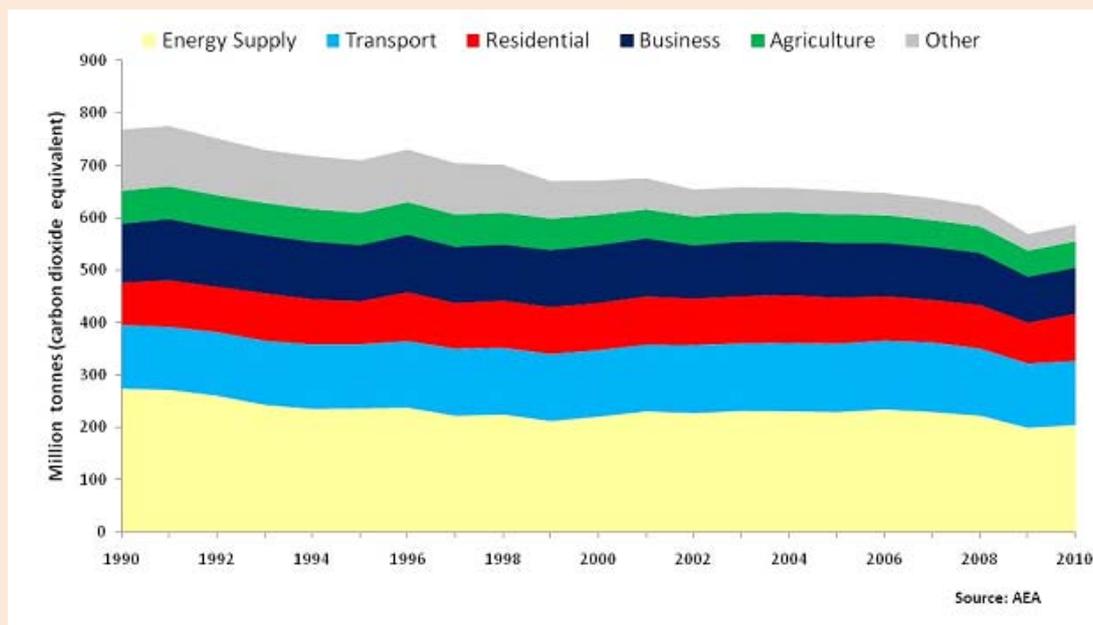
## The UK greenhouse gas inventory

To understand options for reducing Greenhouse Gas (GHG) Emissions, it is first necessary to understand the level, and sources, of current emissions. This information is presented in the form of a greenhouse gas inventory.

The greenhouse gas inventory contains the UK's official GHG emission estimates. It has been compiled annually since 1995 to fulfil the reporting obligations of the UK under the United Nations Framework Convention on Climate Change (UNFCCC) and is the source of our National Statistics on UK GHG emissions. The statistics presented in the inventory are also used to measure progress on UK commitments under the Kyoto protocol. The inventory data underpins the UK Carbon Budgets as set out in the Climate Change Act

The information about UK sources of GHG emissions that the inventory provides is used by Government to help formulate emissions mitigation policies as well as to assess the effectiveness of previously implemented policies.

Emissions are worked out in a number of ways but are generally based on a range of statistical data. Often the calculation is based on an **activity**, for example, burning a tonne of coal. The emission from this activity would be calculated by multiplying the amount of coal used by an **emission factor** (the emissions per unit of activity). Emissions factors vary between sources and can be affected by variables such as fuel characteristics and how the fuel is burned. For some sources, the calculation of emissions is more complicated, and therefore a model is used to make estimations, such as for emissions of methane from waste in landfills.



Greenhouse gas emissions by source, 1990-2010 (published in 2012)

For more information about DECC statistics and the UK greenhouse gas inventory please visit:

<http://www.decc.gov.uk/en/content/cms/statistics/statistics.aspx>

## 1.1 Aims of the Strategy

The Science and Innovation Strategy aims to:

- Describe how we prioritise acquisition of scientific and technical evidence in support of DECC's objectives
- Promote and improve our links with the wider research community by improving access to our current evidence base and sharing our future evidence needs
- Increase understanding of scientific and technical evidence within DECC

The Strategy sets out the work on Science and Innovation that DECC needs to carry out over the current CSR period (April 2011 - March 2015) in order to meet its objectives. We intend to publish an update of the Strategy, detailing progress that has been made, and new challenges that have been identified, in 2013.

## 1.2 Role of Science, Technology and Innovation

Science, technology and innovation are at the heart of the transition to a low-carbon future. As set out in the UK's *Innovation and Research Strategy for Growth*<sup>1</sup>, published by the Department for Business, Innovation and Skills (BIS) in 2011, the UK has the potential to be a world leader in innovation. The Coalition Government is putting innovation and research at the heart of its growth agenda. To succeed in the global innovation economy, the UK must strengthen its ability to accelerate the commercialisation of emerging technologies, and to capture the value chains linked to these. The energy sector offers significant growth opportunities – the IEA estimates<sup>2</sup> that at least 270 trillion dollars of investment will be required in the global energy system between now and 2050 – and the UK is well placed to generate significant exports in this sector. We are currently leading the world in terms of marine energy device and installation development and we have global companies such as Nissan and BMW investing in, and manufacturing, greener vehicles. Major global companies are setting up manufacturing facilities in the UK for offshore wind turbines. This document sets out a range of innovation activities, including in advanced biofuels, CCS and Smart Grids, that DECC is supporting. These sectors, and others, have the potential to contribute to UK economic growth and we will continue to support them.

The development and delivery of policies need to be informed by a sound scientific and technical evidence base. DECC should work with and support innovators and technologists in order to develop and reduce the costs of technologies that are necessary for us to meet the challenging emissions reductions targets that have been set in the Climate Change Act (2008)<sup>3</sup>. Scientists and analysts have a vital role to play in providing the integrated analysis of climate, energy and other societal systems that will be necessary to ensure that UK policies and actions on climate and energy meet our very demanding commitments and objectives.

Understanding how we can achieve the necessary changes in the way energy is generated, distributed and used requires a multidisciplinary evidence base. In addition to undertaking new

<sup>1</sup> <http://www.bis.gov.uk/assets/biscore/innovation/docs/i/11-1387-innovation-and-research-strategy-for-growth.pdf>

<sup>2</sup> IEA Energy Technology Perspectives 2010

<sup>3</sup> The full text of the Climate Change Act 2008 is available at <http://www.legislation.gov.uk/ukpga/2008/27/contents>

analyses, DECC needs to assimilate and synthesise the huge amount of relevant knowledge and information that already exists. This can be achieved only through close collaboration with experts throughout government, and externally with academia, industry and local communities.

As a part of this, DECC recognises the need to put much greater emphasis on the human, social and societal factors governing the success or failure of our policies. Over the last year, our capacity in this area has risen dramatically, and a new social science research strategy to complement this document will be developed in 2012-13. This will set out the priority research needs for DECC and the social science community working in energy and climate change, and a long-term plan for how we will address them, focusing efforts to build a much stronger understanding of people and society.

### 1.3 Science in DECC

#### The role of the Chief Scientific Advisor

DECC's Chief Scientific Advisor (CSA), Professor David MacKay FRS, is responsible for ensuring that DECC makes use of the best available science and engineering advice in policy design, and that decisions are made in a timely and rational manner.

The CSA has responsibility for:

- ensuring that key policy and planning decisions in DECC are evidence based;
- ensuring that DECC has a plan for meeting its renewable energy and greenhouse gas emissions targets that is feasible, costed and deliverable;
- ensuring that DECC develops an effective knowledge management system;
- supporting innovation, where government involvement is justified;
- ensuring excellent advice on climate science;
- accurate reporting of national greenhouse gas emissions;
- acting as Head of Science and Engineering Profession (HoSEP) for DECC; and
- ensuring that the right science and engineering capability and capacity exists within the Department.

The CSA leads the Science and Innovation Group in DECC. This comprises scientists, engineers and statisticians who provide scientific advice and technical analysis to policy teams within DECC; maintain the UK greenhouse-gas inventory<sup>4</sup> and produce national greenhouse gas statistics; lead on international science policy issues (Intergovernmental Panel on Climate Change and under the United Nations Framework Convention on Climate Change); and manage major innovation investment programmes.

The CSA may be called upon to support the Department in the event of an emergency. Decision making during an emergency needs to be based on the best available scientific information. The role of the CSA in an emergency will depend on the nature of the emergency and be guided by Cabinet Office guidance on operations<sup>5</sup>. When the emergency is sufficiently

<sup>4</sup> [http://unfccc.int/national\\_reports/annex\\_i\\_ghg\\_inventories/national\\_inventories\\_submissions/items/5888.php](http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/5888.php)

<sup>5</sup> Responding to Emergencies. The UK Central Government Response.

<http://www.cabinetoffice.gov.uk/sites/default/files/resources/conops-2010.pdf>

serious and requires central government oversight, the Cabinet Office will activate COBR (the Cabinet Office Briefing Rooms and their associated crisis management facilities). DECC's CSA is responsible for ensuring that scientific advice to COBR, where DECC is the lead government department, is co-ordinated, as appropriate, across government. Where the emergency is less serious and requires oversight by DECC only, the CSA will provide scientific advice directly to the lead DECC Minister. For all levels of emergency, DECC's CSA will seek and coordinate relevant expertise from DECC's Scientific Advisory Group and other scientific experts, as needed.

### **Scientific and technical expertise within DECC**

Throughout DECC, teams are involved with projects at all stages of the Research, Development, Demonstration and Deployment spectrum. The scientific and technical research being funded includes climate observations, climate and energy modelling, technology performance testing (as in the case of heat pumps) and experimental research into new technologies. DECC also supports the demonstration and deployment of technologies for renewable energy, smart networks and heat and energy. Further information and detail about DECC's current research can be found in **Section 2** of this report.

In DECC, policy teams are responsible for most aspects of their programmes, including managing evidence needs and budgets for research and consultancy. Consequently experts and specialists are often embedded within policy and delivery teams throughout DECC. For example, the Energy Development Unit (EDU), has a substantial team of geoscientists, geologists, engineers and environmental scientists<sup>6</sup>.

Ensuring communication between all of the specialists in DECC is important, and a Network of Scientists and Technical Leads has recently been established in DECC as a forum for reviewing the evidence bases of policy programmes and sharing best practice (more in **Section 3**).

In 2011/12 DECC will spend ca. £24 million on its science research programme. The Science and Innovation Group will also commit a proportion of the £200 million allocated to DECC over the current Government Comprehensive Spending Review (CSR) period (April 2011 - March 2015) to support the development and demonstration of low-carbon technologies in the UK. DECC also funds scientific and technical evidence-gathering and analysis for policies through the use of technical consultancies. In 2010/11 DECC spent approximately £1.4m on technical consultancy.

It is important to get value for money from the scientific and technical work that we commission. This requires setting clear priorities and asking the right questions. Researchers and experts outside DECC are an important source of advice and analysis. Therefore, establishing and maintaining good networks is key to being able to draw on this expertise. DECC has established a Science Advisory Group (SAG) of leading academics and specialists (see below) and will continue to engage actively with the wider scientific community to ensure that policies are informed by the latest research developments.

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<sup>6</sup> EDU is responsible for licensing and regulating the UK's oil and gas developments, the offshore regulation of CCS and gas storage and the environmental regulation of offshore oil and gas developments, including their decommissioning

In order to ensure a systematic evidence base for effective policy making, it is important for DECC to develop and maintain strong links with other Government departments and their research programmes. Links already exist at a senior level through the Chief Scientific Advisors Committee (CSAC), chaired by the Government Chief Scientific Advisor Sir John Beddington.

We also work through bodies such as the Carbon Trust, Energy Savings Trust, Energy Technologies Institute and Nuclear Decommissioning Authority. These bodies, particularly the Nuclear Decommissioning Authority, manage their own substantial research programmes separately. These are not described in detail in this report. Finally, we work closely with experts from the power sector and other industries.

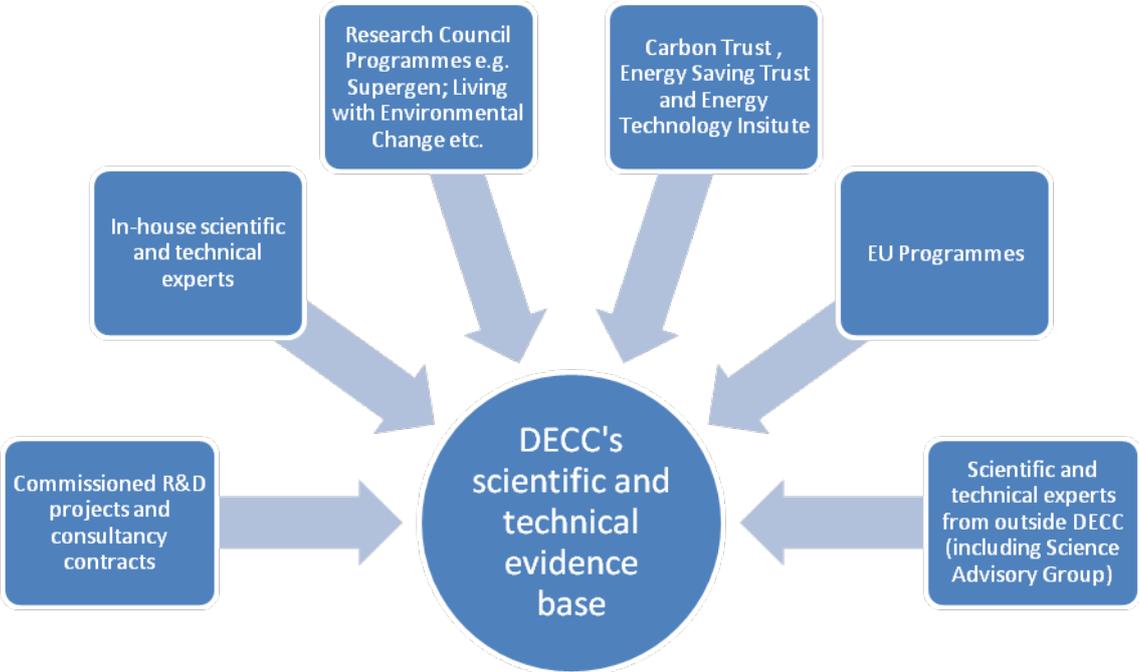


Figure 1 : How DECC gets its evidence and analysis

## Section 2 – Using evidence in policy development

DECC's decision-making on climate change and energy policy needs to be underpinned by timely and sound scientific and technical evidence and analysis. Without this sound evidence base, policy options are unlikely to be well-conceived and may fail to deliver their desired outcomes or result in negative consequences that could have been avoided.

This section of our Strategy provides an overview of the scientific and technical evidence the Department is using to support the design and implementation of our policies, and highlights key evidence needs.

### 2.1 Save energy with the Green Deal and support vulnerable consumers

*Reduce energy use by households and businesses through the Green Deal, and help protect the fuel poor.*

Saving energy is the most effective way to reduce greenhouse gas emissions and reduce the need for investment in additional infrastructure. More efficient buildings also mean lower energy bills, which is particularly important to those in vulnerable groups. We are therefore putting in place measures to:

- Drive greater energy efficiency in households and businesses through the Green Deal;
- Drive greater energy efficiency in central government departments and the public sector;
- Use energy better through rolling out smart electricity and gas meters across Britain;
- Take action to support vulnerable households in meeting the cost of energy bills.

#### 2.1.1 Policy Context

Many homes and business premises in the UK are poorly insulated or use appliances and heating controls in a wasteful manner. DECC is implementing the **Green Deal** and the **Energy Companies Obligation (ECO)** to improve radically the energy efficiency of the UK building stock and so reduce overall energy demand. This will help families and businesses save money on their energy bills.

The roll out of **smart meters** will give people better information about, and control over, their energy consumption and deliver other significant benefits. For example, it will bring an end to the practice of estimated billing and make it easier for consumers to switch energy supplier. Smart meters will also provide a foundation for the better management of energy networks, including enabling more efficient balancing of supply and demand. The rollout is planned to take place between 2014 and 2019, and will require the replacement of 54 million existing gas and electricity meters with new smart meters.

The Government considers a household to be in **fuel poverty** if it needs to spend more than 10% of its income on energy to maintain adequate heating<sup>7</sup>. Living in cold homes can damage people's health and affect their quality of life. Government has policies in place to target the three main factors that influence fuel poverty – household energy efficiency, fuel prices and household income. Our policies include **Warm Front**, **Carbon Emissions Reduction Target (CERT)** and the **Warm Homes Discount**. These will be replaced by the **Green Deal** and the **Energy Companies Obligation (ECO)** which are respectively a financial mechanism and a subsidy, that are designed to allow customers access to energy efficiency and heating system improvement measures at no upfront cost, with ECO particularly targeting low-income and vulnerable households. On incomes, the **Winter Fuel** and **Cold Weather Payments** provide an important source of support towards the costs of heating for vulnerable households.

### 2.1.2 Science programmes

DECC needs to ensure that the energy savings measures which are recommended to Green Deal participants are able to deliver real energy savings. DECC has commissioned a range of *in situ* performance tests of energy efficiency technologies to improve our understanding of the impacts of interventions in homes and provide evidence to assist further policy development. These include measurements of the effectiveness of insulation in UK homes, of the performance of condensing boilers, and of how much energy advanced heating controls can save.

DECC is also closely involved in field trials of air- and ground-source heat pumps, including acoustic tests and investigations of installation best practice. Analysis of this work by staff in DECC has highlighted the positive effect that improving installation standards could have on heat pump performance and as a result, following proactive engagement with industry experts, new requirements for contractors<sup>8</sup> were published in September 2011.

In addition, we recently completed an investigation into the technical problems associated with insulating *hard to treat* cavity walls<sup>9</sup>. By improving our understanding of the different types of cavity walls that exist in the UK we have been able to better assess the remaining potential that there is to insulate these cavities and have greater certainty about what the costs of doing this might be.

Understanding energy use patterns across all end-use sectors is vital to the creation and monitoring of energy policies. DECC scientists and statisticians provide this capability through the use of modelling, field surveys and the development of indicators, working closely with other Government Departments. In particular we contribute to the Department of Communities and Local Government led English Housing Survey (EHS)<sup>10</sup> that provides information about the type and condition of housing in England. The survey is undertaken by professional surveyors on a random sample of housing and amongst many other aspects includes information on energy efficiency measures like insulation. The data obtained from the EHS over many years are potentially very useful to many organisations and we have been working with partners to improve data access.

<sup>7</sup> Following publication of the Hills Fuel Poverty Review in March, DECC will consult on an alternative definition for fuel poverty in the summer – [http://www.decc.gov.uk/en/content/cms/funding/fuel\\_poverty/hills\\_review/hills\\_review.aspx](http://www.decc.gov.uk/en/content/cms/funding/fuel_poverty/hills_review/hills_review.aspx)

<sup>8</sup> <http://www.microgenerationcertification.org/admin/documents/MIS%203005%20Issue%203%200%20Heat%20Pump%20Systems%202011.09.05.pdf>

<sup>9</sup> [http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving\\_energy/analysis/788-hard-to-fill-cavity-walls-domestic.pdf](http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving_energy/analysis/788-hard-to-fill-cavity-walls-domestic.pdf)

<sup>10</sup> <http://www.communities.gov.uk/publications/corporate/statistics/ehs200910householdreport>

DECC also funds the Energy Follow-up Survey (EFUS), which is collecting data during 2011/12. This uses a sample of households from the EHS to get an up-to-date understanding of how energy is being used in homes. It consists of interview surveys of 2,600 households, profiling of electricity use in 100 homes (to understand time-profiling of electricity use) and temperature monitoring of 1000 homes for a full year. EFUS will provide information on the temperatures to which people actually heat their homes (and how long for), as well as gathering evidence on summer overheating across the housing stock.

Our analysts and scientists have also been developing modelling solutions to estimate household energy consumption, estimate the uptake of insulation and heating measures and simulate the effects of different energy policies. The Cambridge Housing Model (CHM) uses information from the EHS to estimate use of energy in homes split by heating, lighting, appliances and cooking. It applies weighting factors to the EHS data in order to generate information across the UK. The model also estimates the take up of key insulation measures in homes, which allows the calculation of the number of households that have not yet installed these measures but could potentially do so. Outputs from the model are reported in the Housing Energy Fact File<sup>11</sup>.

DECC is also currently developing a National Energy Efficiency Data Framework (NEED) which will draw on the wide range of existing data sources to provide the Department with a greater understanding of energy consumption and the impacts of energy efficiency measures. The data framework matches the gas and electricity consumption data collected for DECC Sub-national energy consumption statistics<sup>12</sup> with records of energy efficiency measures in the Homes Energy Efficiency Database (HEED)<sup>13</sup> run by the Energy Savings Trust (EST). It also includes qualitative data about dwellings and households obtained from a variety of sources. By bringing these sources of data together, NEED will help inform policy development and policy evaluation.

To aid the development of the Smart meters programme, DECC and Ofgem funded the Energy Demand Research Project (EDRP). This large scale project, involved 60,000 homes (including 18,000 households with smart meters) and four major energy suppliers, and was designed to test consumers' responses to different forms of information about their energy use. The interventions used were primarily directed at reducing domestic energy consumption, with a minority focused on shifting energy use from periods of peak demand. The final project report was published in June 2011<sup>14</sup> and its findings include the impacts of the different interventions on energy consumption (the first time this has been available for British homes on such a large scale) and insights into key practical and technical issues that will be of use to the successful rollout of smart meters.

In order to understand better the cost effectiveness of installing different measures to help alleviate fuel poverty, DECC has commissioned research into how household energy efficiency increases as measures are installed, based on the Standard Assessment Procedure (SAP)<sup>15</sup>.

<sup>11</sup> Great Britains Housing Energy factfile, BRE 2011- available on DECC publications, previous versions from 2008 and 2006 are also available

<sup>12</sup> <http://decc.gov.uk/en/content/cms/statistics/regional/regional.aspx>

<sup>13</sup> <http://www.energysavingtrust.org.uk/business/Business/Information/Homes-Energy-Efficiency-Database-HEED>

<sup>14</sup> <http://www.ofgem.gov.uk/sustainability/edrp/Pages/EDRP.aspx>

<sup>15</sup> SAP is a methodology used by the UK Government to assess and compare the environmental performance of dwellings. It was developed by the Building Research Establishment (BRE 1992) and provides an assessment of dwelling energy performances that is needed to underpin energy and environmental policy initiatives.

Research is also being done on quantifying and monetising the health impacts of improving the thermal efficiency of the housing stock as well as modelling work to help estimate potential impacts of policies on energy bills.

DECC is building evaluation into key policies including Green Deal, Smart Meters, CERT and Warm Home Discount, to ensure we have a comprehensive understanding about the actual impacts of our policies, and how they are delivered.

### 2.1.3 Long-term strategy and Evidence needs

DECC analysis suggests that the most cost effective routes to our decarbonisation targets involve significant improvements in the efficiency of UK domestic and commercial buildings. To deliver this outcome we need evidence on the effectiveness of physical interventions (e.g. solid wall insulation), information on new products and technologies that could lead to improved energy efficiency (including 'Smart' controls) and understanding of how people use energy within buildings, and how this behaviour can be influenced in a positive way.

Knowledge about what smart meter technology can deliver and how people will use it are central to achieving the desired benefits. DECC will commission research to increase our understanding in these areas before and during the rollout. An evaluation plan for smart meters will be published in 2012 to complement the roll-out of the programme and to help maximise the delivery of the predicted benefits to consumers.

We are continually looking to improve our understanding of the drivers and implications of fuel poverty as well as investigating new ways of addressing it. We are developing a methodology to allow us to quantify and monetise the health impacts of improving household thermal efficiency. This requires an improved evidence base across three areas:

- Impact of improved housing on internal temperatures (i.e. level of comfort taking);
- Impact of warmer internal temperatures on health outcomes (including mental health outcomes);
- Monetising the impact of improved health outcomes on UK PLC (e.g. NHS cost savings)

More evidence is also needed to understand:

- The effectiveness and appropriateness of non-conventional heating systems (such as air and ground source heat-pumps) for low-income and vulnerable households;
- Home-heating behaviour – including what the key drivers of under-heating are for low-income groups; what trade-offs low-income households are forced to make between heat and other goods; how home heating behaviour changes as a result of thermal efficiency improvements; and
- Wider social impacts of persistent fuel poverty (quantitative and monetised) for example on education.

Innovation supporting the development of new materials (e.g. novel types of insulation) could help improve the efficiency of the UK building stock. Process and design innovation that improve the way that new and existing energy efficiency technologies are installed, operated and monitored could have a significant impact on the efficiency of both existing UK buildings, and new-build.

The Green Deal also covers non-domestic buildings, the evidence base for which is being updated. DECC has started the process of improving its understanding of the energy efficiency of the non-domestic building stock, how organisations use energy, their scope to reduce

energy use and the role played by behavioural and organisational factors. This deeper understanding of how organisations use buildings will help identify appropriate interventions to reduce overall energy consumption.

## 2.2 Deliver secure energy on the way to a low-carbon energy future

*Reform the energy market and work internationally to ensure that the UK has a diverse, safe, secure and affordable energy system and incentivise low-carbon investment and deployment.*

Significant investment is needed in the UK energy system to ensure that we continue to have access to secure, safe and sustainable energy. Investment decisions over the next decade in nuclear, renewable and fossil-fuel powered infrastructure, will play an essential part in determining whether or not long-term targets to decarbonise the energy system are met. It is important that the energy market in the UK support the deployment of low-carbon infrastructure, and in a way that minimises costs to consumers. We will therefore:

- Reform the electricity market to ensure fair competition and secure gas and electricity supplies
- Drive deployment of renewable energy across the UK to ensure that at least 15% of UK energy comes from renewable sources by 2020
- Facilitate the world's first new nuclear development without public subsidy by 2018
- Support the development of CCS technology at scale in a commercial environment, to bring down costs and risks, with £1 billion set aside to support the programme;
- Set in place a framework to establish a smart electricity grid
- Set in place reforms to the electricity grid to ensure sufficient capacity and access to connect new forms of energy generation
- Work to ensure that international action supports the UK's low-carbon development and energy security objectives
- Maximise recovery of the UK's indigenous oil & gas reserves.

### 2.2.1 Policy Context

DECC published a White Paper on **electricity market reform (EMR)**<sup>16</sup> in July 2011. This aims to deliver the market conditions which will facilitate the cost effective construction of new low-carbon electricity generation to deliver secure UK energy supplies and meet requirements<sup>17</sup> set out in the **2009 EU Renewable Energy Directive**<sup>18</sup>; and to enable a reduction of UK greenhouse gas emissions of at least 35% by 2020.

The current mechanism for supporting large scale generation of renewable energy is the **Renewables Obligation**, which places an obligation on licensed electricity suppliers to source a specified and annually increasing proportion of their electricity sales from renewable sources. Support is available for smaller scale low-carbon electricity generation through **Feed-in-tariffs**

<sup>16</sup> Information about the EMR can be found at [http://www.decc.gov.uk/en/content/cms/legislation/white\\_papers/emr\\_wp\\_2011/emr\\_wp\\_2011.aspx](http://www.decc.gov.uk/en/content/cms/legislation/white_papers/emr_wp_2011/emr_wp_2011.aspx)

<sup>17</sup> That 15% of energy consumed in the UK is produced from renewable sources

<sup>18</sup> Directive 2009/28/EC of the European Parliament and of the Council – of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing directives 2001/77/EC and 2003/30/EC <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF>

which guarantee a price for renewably sourced electricity for generation up to 5MW. The EMR will replace the Renewables Obligation by the end of the decade.

As well as supporting renewable electricity generation, DECC has launched the **renewable heat incentive (RHI)**, a mechanism that encourages the use of renewable energy for heating in domestic and non-domestic buildings. Approximately 47%<sup>19</sup> of the energy consumed in the UK is for heating, and a big reduction in the carbon intensity of the heat we use is vital if we are to meet our emissions reductions targets. The RHI opened for applications at the end of November.

The Government believes that new nuclear power should be free to contribute as much as possible towards the UK's need for new low-carbon capacity. DECC aims to

- Make it possible and practicable to build new nuclear power stations in England and Wales by removing unnecessary barriers to the deployment of the technology
- Help nuclear power to meet its potential as the lowest cost form of low-carbon technology
- Enable deployment of the first new nuclear power station from 2019, without public subsidy, and an ongoing programme of new stations in the following years<sup>20</sup>.

DECC has been working on delivering planning reforms that will make it possible and practicable to build new nuclear power stations in England and Wales. The **National Policy Statements (NPSs)** provide blueprints for decision making on individual applications for development consent for nationally significant energy infrastructure. The NPSs were submitted to parliament in summer 2011.

Fossil fuels will continue to play a key role in meeting our energy needs as we make the transition to a low-carbon economy. The successful development and deployment of carbon Capture and Storage (CCS) is an important step towards decarbonisation as it will allow fossil fuel power stations to continue to function while reducing their emissions of CO<sub>2</sub> by up to 90%<sup>21</sup>. The continued availability of flexible, fossil fuel powered electricity generation capacity will also enhance security of supply<sup>22</sup> as part of a diverse electricity mix that will include intermittent renewables and continuous nuclear power.

The next step for CCS is to bring down the costs and risks of the technology by supporting its development at scale in a commercial environment. The Government is firmly committed to supporting CCS. There are a number of promising CCS projects proposed in the UK and we expect to commence a selection process as soon as possible in 2012, with £1bn set aside to support the programme. The Government is also undertaking other actions which will be set out in a CCS roadmap that will be launched alongside the call for projects.

The policies outlined above will alter profoundly the ways that power is generated and distributed in the UK. DECC is working to ensure that the electricity network is able to adapt to

<sup>19</sup> Energy Trends September 2010, Special Report on Estimates of heat use in the United Kingdom – Table 1. Available at <http://www.decc.gov.uk/assets/decc/Statistics/publications/trends/558-trendssep10.pdf>

<sup>20</sup> This is without prejudice to the Secretary of State's decision making role on individual applications for development consent.

<sup>21</sup> IPCC special report on Carbon Dioxide Capture and Storage. Prepared by working group III of the intergovernmental Panel on Climate Change. Metz, B., O. Davidson, H.C. de Coninck, M Loos, and L.A. Meyer (eds.) Cambridge university Press, Cambridge, United Kingdom and New York, NY, USA, 442 pp. Available in full at [www.ipcc.ch](http://www.ipcc.ch)

<sup>22</sup> Parsons Brinckerhoff (2011). *Electricity Generation Cost Model 2011 Update*, available from: [www.decc.gov.uk](http://www.decc.gov.uk).

deal with these changes, with sufficient capacity and the necessary versatility to handle more intermittent renewable energy sources. This larger, smarter grid, together with other elements of the new electricity system, such as smart meters, micro-generation of electricity by individuals and businesses, smart appliances and electric vehicles, will also offer consumers new opportunities for greater control over and choice in how they use electricity. The development of a smart grid lies at the centre of this vision for a transformed low-carbon electricity system. It forms the backbone of the new system, and will need to be intelligent, flexible and responsive.

In the medium term the UK will continue to depend on oil and gas for many of our energy needs as we make the transition to a low-carbon economy. We aim therefore to maximise the economic recovery of oil and gas from the UK's oil and gas reserves, taking full account of environmental, social and economic objectives.

Oil and gas activities in the UK are subject to one of the most robust regulatory regimes in the world, and it is important that we keep our safety systems and response capability as up-to-date as possible. The huge oil spill in the Gulf of Mexico during 2010 was a reminder of what can happen when things go wrong. Specialists within DECC are studying the findings from the formal US investigations into the spill and are contributing to the review of the UK regulatory regime that is currently taking place.

### 2.2.2 Science and Innovation programmes

As the UK puts in place policies to drive emissions reductions, it is essential that these policies are technically sound, otherwise meeting our Carbon Budgets could become more difficult and costly. A critical issue is the need to understand *system issues*, such as how the use of a low-carbon fuel in one sector such as housing may decrease its availability for another. We must also consider issues of *energy security*, with a particular focus on resource supplies.

#### 2050 Calculator

The 2050 Pathways Analysis<sup>23</sup> presents a framework through which to explore a range of potential energy pathways from today to 2050. It allows us to consider some of the choices and trade-offs that we will have to make in achieving the UK's long-term greenhouse gas emissions target of an 80% reduction by 2050<sup>24</sup>, while ensuring the UK's energy needs are met.

The 2050 Calculator<sup>25</sup> is a user-friendly computer model based on DECC assumptions about plausible rates of technology deployment which lets users create their own UK emissions reduction pathway to 2050. This allows individuals to see the impact on energy and emissions of different choices on energy investment, using real UK data on the impact of measures to supply energy and reduce energy demand. The user can choose between options representing different levels of effort for each of the supply and demand sectors in the UK energy system. The overall message from the 2050 Analysis is that meeting the UK 2050 emissions target is challenging but achievable, as a number of illustrative pathways to 2050 show. These illustrative pathways facilitate a discussion about the long-term options available, including the choices and trade-offs that could be made, and point to a set of actions which

<sup>23</sup> <http://www.decc.gov.uk/en/content/cms/tackling/2050/2050.aspx>

<sup>24</sup> <http://www.legislation.gov.uk/ukpga/2008/27/contents>

<sup>25</sup> <http://www.decc.gov.uk/en/content/cms/tackling/2050/2050.aspx>

appear to be common to a number of the possible pathways, including energy efficiency, flexibility and diversity of supply.

The findings of the project were first made publicly available as a Call for Evidence in July 2010 and were updated following this Call for Evidence and re-published in March 2011. Full details, including the full 2050 Calculator available as an Excel Workbook, can be found at: <http://www.decc.gov.uk/en/content/cms/tackling/2050/2050.aspx>

## Environmental impact of energy supply

It is important to understand the effects that energy generation technologies might have on the local as well as the global environment. Strategic Environmental Assessments (SEAs) for offshore energy are carried out within DECC as part of a rolling programme. Work is also done to assess and review when a new SEA should be started (in light of new information on technologies, effects or plan/programme status) and to update environmental baseline data regularly. SEAs are required for developments such as for oil and gas infrastructure, offshore wind farms or for one-off projects such as using the tidal range of the Severn estuary to generate electricity. DECC also commissions Individual projects looking into specific aspects of the environmental impacts of energy infrastructure. These have included reports and studies on:

- the health and nuisance effects of shadow flicker<sup>26</sup> from wind turbines on humans
- the noise impacts from wind turbines<sup>27</sup>;
- the impacts of wind turbines on bats; and
- the potential impacts of oil and gas operations on cetaceans (whales, dolphins & porpoises) in the Moray Firth.

## Bioenergy, nuclear power and Carbon Capture and Storage

Analysis suggests that in most scenarios the use of biomass is a necessary part of a decarbonised energy system. Biomass use in the energy system gives rise to complex issues, with many potential technological solutions, competing demands (since use of cropland for biomass production has an impact on food production), and emissions accounting issues that require consideration. DECC is working with other government departments having interests in the use of biomass to determine how it should best be used in the UK. These include Defra, as the department responsible for agriculture and rural land-use; DfT, who have an interest in bio-fuels for transportation; and DfID and FCO, which need to consider the international aspects of the use of biomass.

Renewed global interest in nuclear power has increased the need to understand the potential benefits of new reactor and fuel cycle technologies. DECC is funding work to explore the relevance of these technologies for the UK's energy future and looking at development options both nationally and internationally. The nuclear industry relies on a highly skilled workforce and

<sup>26</sup>Update of UK Shadow Flicker Evidence Base, DECC, 16<sup>th</sup> May 2011 – Available at <http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/renewable%20energy/ored/1416-update-uk-shadow-flicker-evidence-base.pdf>

<sup>27</sup>Analysis of How Noise Impacts are Considered in the Determination of Wind Farm Planning Applications, Hayes McKenzie Partnership Ltd, 6<sup>th</sup> April 2011 - Available at <http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/wind/2033-how-noise-impacts-are-considered.pdf>

DECC is also playing a major role, with BIS, to consider how to provide the necessary skills base for the industry and to enable the UK to take advantage of appropriate new technology opportunities when they arise.

The individual processes involved in CCS, which are capture, transport and storage, are not new but have yet to be employed together at commercial scale in power generation. This has been identified as a barrier to CCS deployment and the Government's CCS programme will address this by providing support for the development of the technology at scale in a commercial environment. We are also funding, or co-funding, a number of science and engineering projects investigating aspects of carbon abatement technologies. These projects include:

- technology development projects under the CAT Demonstration Programme (e.g. oxyfuel combustion and operation of post-combustion capture projects); and
- International collaboration projects with the EU (e.g. CO2ReMoVe) and in support of our Memorandums of Understanding with other countries such as China (e.g. biomass co-firing and Chinese advanced power plant carbon capture options (CAPPCCO) projects).

In addition to ongoing oil and gas industry regulation and safety work, DECC also funds research into a variety of subjects, including Enhanced Oil Recovery (EOR) and understanding reservoir properties through the PILOT taskforce. This is a joint programme involving the Government and the UK oil and gas industry which aims to secure the long term future of the Industry in the UK. Examples of work undertaken through this initiative include:

- Carbonated Water Injection Studies – Advanced the understanding of how combining CO<sub>2</sub> and water injection to displace oil can improve recovery in North Sea fields. This will help de-risk the development of CO<sub>2</sub> injection EOR projects which in turn may help the UK accelerate the uptake of Carbon Capture & Storage projects (CCS).
- Water Alternating Gas (WAG) Injection Studies – This study has developed new algorithms for predicting reservoir sweep when gas and water are co-injected to displace oil. These new methods will improve confidence in forecasting incremental oil production from EOR projects in the North Sea. The benefit to DECC is more EOR projects and helping maximising production from the UK's oil & gas resource

### Case Study – INEOS BIO advanced biofuels/bio-refinery plant

DECC and the Regional Development Agency for north east England are providing support to INEOS Bio Ltd to design and construct an advanced biofuels /biorefining demonstration facility at Seal Sands, Stockton-on-Tees. The plant will convert locally generated biodegradable household and commercial wastes into bioethanol and renewable electricity, as well as aggregates for use in construction. The first phase of the project is due for completion in 2012 and will produce, approximately 24kt of bioethanol per annum and 7MW renewable power with approximately 3MW exported to the grid. If successful, the plant could be expanded to produce approximately 126kt pa of bio-ethanol and 40MW renewable power, with 17MW exported.

The INEOS Bio process is a combined thermo-chemical and bio-chemical technology. The gasification of Municipal Solid Waste (MSW) is challenging, since MSW is an inhomogenous resource, varying both temporally and spatially. At the heart of the process is an anaerobic fermentation step, through which naturally occurring bacteria convert syngases derived through a propriety gasification system into bio-ethanol.

Demonstrating technical and commercial viability of these innovative processes should help increase deployment and play an important part in helping meet EU and UK renewable energy targets, and other climate change goals including carbon abatement, and sustainable waste management. The construction and operation of the INEOS demonstration plant will also provide new jobs and contribute to economic regeneration in the North East.

The production of advanced transport biofuels are particularly important from a sustainability perspective, as they often have better greenhouse gas savings than the conventional 1<sup>st</sup> stage biofuels, and using wastes as feedstocks can avoid some of the land use competition issues (food security, indirect land use change impacts) which can arise when making fuels from agricultural crops.

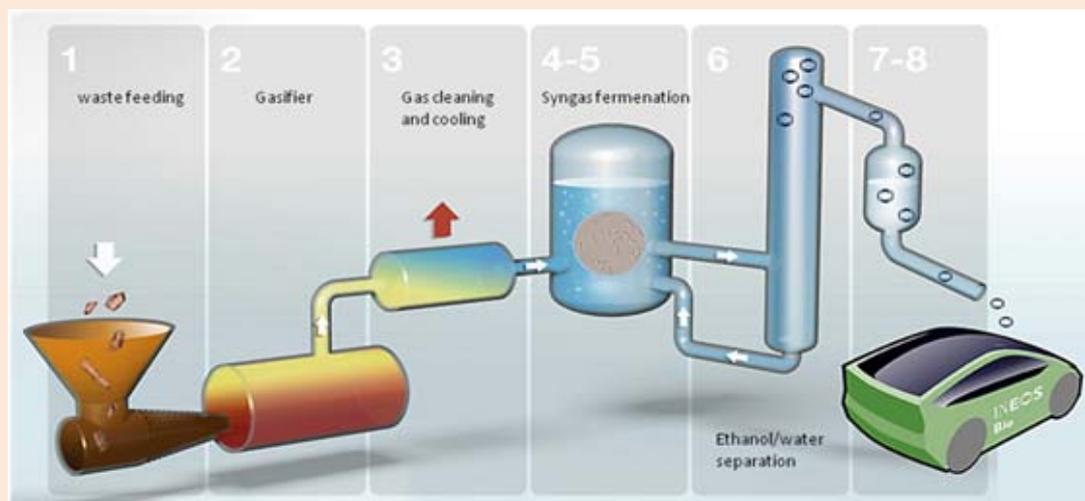


Figure: Biorefinery plant process diagram

### Case Study – Ferrybridge CCS

Following completion of its construction phase, the Ferrybridge Carbon Capture Pilot (CCPilot100+) Project was launched on 30 November 2011. The project is the UK's largest carbon capture pilot. The project will use amine based post combustion capture (PCC) technology to capture CO<sub>2</sub> from a slipstream of flue gas taken from a working coal fired power station. The aim is to prove the application of the amine solvent PCC process under realistic operating conditions

The total cost of this project is more than £20m, of which DECC, the Technology Strategy Board and Northern Way contributed more than £6m. Industry partners in the project are Scottish and Southern Energy (SSE), Doosan Power Systems and Vattenfall. University researchers from Nottingham, Edinburgh, Leeds and Sheffield universities will also participate in the project to gain experience, execute complementary research and build UK capacity in CO<sub>2</sub> capture.

The project is located at SSE's Ferrybridge power station and has the capacity to capture up to 100tCO<sub>2</sub>/day, equivalent to 5MW of electrical power. The project aims to increase experience in the operation of post-combustion capture on coal with biomass co-firing. Subjects for investigation will include assessing the effects of station running schedule/regimes upon PCC performance; how to optimise the process and components and develop performance models covering process capability, stability, transient flexibility, energy requirements, amine degradation, and materials performance through solvent and process testing; as well as benchmarking Doosan's capture technology process against similar processes.

This project is a critical bridge from research to commercialisation for a CO<sub>2</sub> capture technology that can be used both for new power plant and for retrofit to existing coal and gas power plants. It will provide data and experience that will be invaluable in the near-term scale up and deployment of CCS and move us closer to our long term aim: cost competitive CCS deployment by the 2020s. The project represents a clear and strong business opportunity for the UK –in particular the British suppliers who have supplied many of the component parts - and will help the UK develop global market opportunities.



Ferrybridge Power Station image, courtesy of Scottish and Southern Energy

## Smart grids

DECC contributed approximately £2.6 million to demonstrate Smart Grid technology during 2009/10 and 2010/11 through innovation support funds. The objective of the Smart Grid Capital Grants Programme was to foster ongoing learning, capability development and evaluation in the emerging space of smart grid. The programme supported industry led projects including:

- A Smart Grid demonstration system able to demonstrate the remote monitoring and automatic control of active generation and distribution elements. This should provide a good showcase and allow utilities companies to perform their own smart grid trials and demonstrations.
- The construction and deployment of grid connected energy storage at a Biomass energy plant.
- The installation of dynamic demand technology at 200 sites to demonstrate the potential this has for reducing the need for operational reserves to be held on conventional plant.
- The implementation of an Active Network Management scheme, integrating demand side management with an energy storage device

The capital expenditure for these projects has now been committed. Once the projects have been fully evaluated later this year, the findings will be published on the DECC and Energy Networks Association website.

## DECC Support for Energy Innovation

New or improved energy technologies are needed in the UK and the rest of the world if we are to decarbonise our energy systems and maintain energy security in a safe and cost effective manner over the long term. However, because low-carbon technologies often take 10 or more years to develop, government intervention is often required to overcome market failures and support deliver technologies to market. DECC supports and funds innovation activities, specifically aiming to:

- Reduce the cost of existing low-carbon technologies;
- Develop new technologies to give the UK a portfolio of energy sources, supporting secure and affordable energy; and
- Make the UK a more attractive place to develop new low-carbon technologies to support our longer term greenhouse gas emission goals.

The Carbon Plan (see Section 2.3.1) highlights the important role low-carbon innovation will play in order to ensure that the fourth, and subsequent, Carbon Budgets are to be met. This innovation will transform UK infrastructure to support the transition to a low-carbon economic base. The plan recognises the role low-carbon Innovation can play in promoting UK economic growth through creating opportunities for UK businesses to capture a greater share of the global low-carbon market. This market was worth more than £3.2 trillion in 2009/10 and is projected to reach £4 trillion by 2015 as economies around the world invest in low-carbon technologies across a broad range of sectors. The UK share of the market was more than £116 billion in 2009/10, and could be much larger.

DECC operates mainly at the development, demonstration and pre-commercial deployment stages of the innovation chain, with other players funding earlier stage research (see Figure 2 below). We aim to help bridge the potentially lengthy gap between a technology being ready, and being widely deployed. Research Councils, the Technology Strategy Board, the Carbon Trust and the Energy Technologies Institute are also involved in supporting technology

research, development and demonstration. Our support for energy innovation tends to work in three ways:

- Technology *push* is direct funding for demonstration and pre-commercial deployment.
- Market *pull* is indirect funding, through mechanisms such as the Renewables Obligation, Feed-In-Tariffs and Emissions Trading
- Barrier removal aims to address the areas which slow development down, such as planning and grid issues.

The November 2010 spending review announced funding of over £200 million for low-carbon technologies over the four financial years from April 2011. This includes up to £60 million for the development of offshore wind manufacturing at UK ports.

Plans for the allocation of this innovation funding are now well advanced. We have had to make some difficult choices to make in prioritising spend on innovation, and we will be focusing on those technologies and programmes where intervention will have the greatest impact on meeting the Governments climate change and energy objectives.

To help make these choices the Low Carbon Innovation Coordination Group (LCICG, formed from relevant government bodies<sup>28</sup>), has been developing **Technology Innovation Needs Assessments**. These consider the state of development and potential in a range of key low-carbon technology families to help inform targeted allocation of our funds. A Plans for new DECC technology programmes, and the launch of some individual schemes, have already been announced, with more announcements expected in the coming months.

### How other bodies support energy innovation in the UK

The UK innovation landscape for renewables is complex. Figure 2 illustrates how UK organisations support innovation for technology at different Technology Readiness Levels (TRLs).

In 2011 DECC led a review of the low carbon innovation delivery landscape which focused on enhancing the delivery of publicly funded innovation support for low carbon innovation technologies for this spending review period (2011–15) and beyond, but also capturing learning from what has gone before.

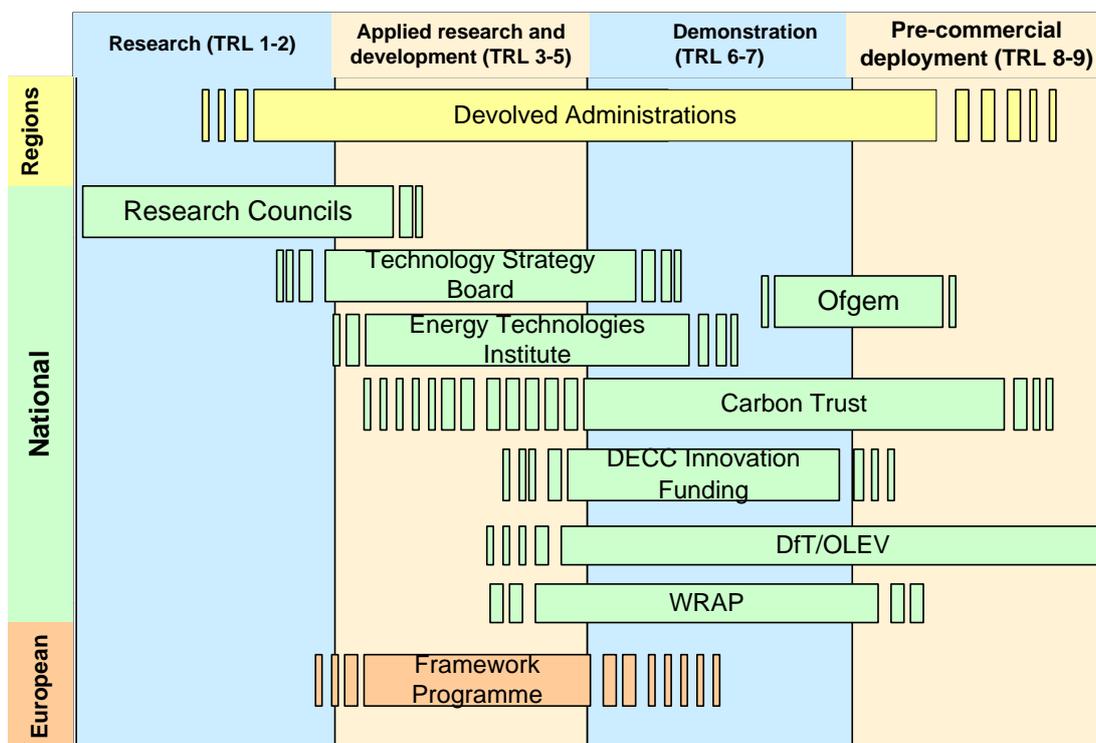
The report looked at the low carbon innovation landscape and delivery issues highlighted by different reviews and considers appropriate solutions and interventions to improve the effectiveness of public direct support for low carbon innovation. It focused in particular on embedding the recommendations of the NAO report on the planning and management of innovation support.

Based on the outcomes of the review, DECC and other Government Departments and organisations including the Technology Strategy Board (TSB), the Energy Technologies

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<sup>28</sup> LCICG comprises of the major public funders of low carbon innovation in the UK. Its core members are DECC, BIS, Carbon Trust, Energy Technologies Institute, Technology Strategy Board, Research Councils UK, Scottish Government and the Scottish Enterprise. In addition, associate members have interests in specific low carbon technologies participate in the group's activities as and when they feel it is appropriate. Associate members include, for example, DFT, DEFRA, OFGEM and the Welsh Assembly.

Institute (ETI), the Carbon Trust, the Devolved Administrators and WRAP will work together to **strengthen and enhance Government's vision and strategic objectives for low carbon innovation**. The Low Carbon Innovation Coordination Group (LCICG) will be re-launched, ensuring it has full policy coverage of technologies, and includes all departments and bodies with key low carbon innovation interests. The LCICG will develop and adopt a toolbox of strategic outcomes and metrics.



**Figure 2 : The technology funding landscape**

**To ensure effective prioritisation, planning and appraisal**, the LCICG partners will further develop and draw on its shared Technology Innovation Needs Assessment (TINA) evidence base to develop technology plans and ensure prioritisation is consistent.

**To enhance delivery and monitoring of programmes**, LCICG members will deliver programmes by conducting appropriate appraisal, post project evaluation and share lessons learnt across government, in line with best practice.

We will also create greater **transparency and innovator access** by building on and strengthening the funding support navigator<sup>29</sup>, so it covers a full range of low carbon innovation technologies and is accessible via relevant channels. An LCICG document will also be published setting out our collective objectives and plans.

### Energy Research Partnership

The Energy Research Partnership (ERP) brings together key stakeholders and funders of energy research, development, demonstration and deployment in Government, industry and

<sup>29</sup> [www.lowcarbonfunding.org.uk](http://www.lowcarbonfunding.org.uk)

academia, plus other interested bodies, to identify and work together towards shared goals. The Partnership has been designed to give strategic direction to UK energy innovation, seeking to influence the development of new technologies and enabling timely, focussed investments to be made. It does this by (i) informing members in their respective individual roles and capacities and (ii) communicating views more widely to other stakeholders and decision makers as appropriate. ERP's remit covers the whole energy system, including supply (nuclear, fossil fuels, renewables), infrastructure, and the demand side (built environment, energy efficiency, transport).

ERP is co-chaired by the DECC CSA and Nick Winser, Executive Director at National Grid. A small in-house team provides independent and rigorous analysis to underpin ERP's work.

- A preliminary technology roadmap for nuclear fission published by ERP in February 2012 has fed into the development of a Government response to the House of Lords inquiry on nuclear capability, and will lead to further detailed work by DECC in the area.
- DECC's Technology Innovation Needs Assessments have had input from ERP in 2011, including through workshops (on energy storage and bioenergy), from reports (on energy storage and nuclear fission) and in direct discussion with Members following presentation of preliminary findings to an ERP meeting.
- An Energy Storage Innovation Forum is being established by ERP to coordinate activities and develop strategic priorities for energy storage technologies, with key stakeholders from DECC, funding agencies, regulators and industry.
- ERP's work on 'managing intermittency' is informing development of Electricity Market Reform with the publication of an ERP report in March 2012, and follow-up roundtable discussions planned for Spring/Summer 2012.
- Direct discussions between ERP Members and senior officials in DECC are informing the development of a cross-Government bioenergy strategy to take forward recommendations of ERP's Bioenergy Review, published in 2011.
- A UK-Norway workshop, organised by ERP with UKERC in June 2011, looked at technical, policy and regulatory challenges to developing a North Sea Offshore Network. Participants included DECC officials, industry and academics from the UK and Norway. The discussion and outputs have informed UK position within the North Sea Countries' Offshore Grid Initiative (NSCOGI).
- ERP has submitted responses to consultations from DECC, including on Energy Efficiency (in 2012, with ERP's Industrial Energy Efficiency report), the Heat and Energy Saving Strategy (in 2009, following a joint ERP-Royal Academy of Engineering workshop on Heat); and CCS (in 2008 and 2009, following discussions at ERP meetings).

## Research Councils

Basic research into new technologies in the UK is undertaken by the Research Councils via their Energy Programme, which has an annual budget of approximately £110million and is designed to deliver a broad spectrum of energy-related research and postgraduate training. This includes support for the UK Energy Research Centre<sup>30</sup> (UKERC). DECC is represented on UKERC's Energy Programme Science Advisory Committee which sets the strategic direction and funding allocations for the Programme.

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<sup>30</sup> <http://www.ukerc.ac.uk>

### 2.2.3 Long-term strategy and Evidence needs

We need continually to update and improve our understanding of systems issues and the interactions between different policies to enable the development of the most appropriate policy responses and future strategies. Important questions include:

- How will changes in supply and demand for fossil fuels impact on different scenarios and pathways for 2050?
- What is the optimum mix of measures on the supply side (e.g. renewable energy infrastructure, CCS and nuclear power plants) and measures on the demand side (particularly around energy efficiency) that enable the UK to meet its long-term decarbonisation target
- How do different parts of the electricity system interact (e.g. what does deployment of renewables imply for investment in the UK electricity network)
- What are the potential impacts of the increasing scarcity of materials, such as rare earth metals used in energy storage?

The weather conditions that exist in and around the UK support the deployment of significant levels of renewable electricity capacity. We need to understand more fully how climate change might affect our weather systems and what the effects of any changes might be for wind, solar and wave generation as well as for the availability of biomass.

Renewable energy technologies are continually evolving and developing and we need to ensure that the UK is in a position to benefit from these developments. We need reliable information on the performance of new technologies from real world tests. Technologies which we need to know more about now include air-source heat pumps and reversible heat pumps.

We have already highlighted the importance of CCS for achieving our decarbonisation goals and are investing considerable amounts of funding in to the CCS programme. This will provide us with a huge amount of information that will be important in developing CCS and in driving its costs down. A clear need is to develop knowledge management systems to ensure that the information acquired from projects are utilised as effectively as possible to assist the CCS industry both in the UK and abroad. Information gained from detailed technical and engineering studies completed as part of the first competition has been made publicly available via the DECC website<sup>31</sup> to help speed up deployment of CCS. We need to engage with other successful large scale technology projects to understand how they have achieved this, particularly in light of the competing commercial and public interest pressures. There is also a need for better information on the realistic availability of geological storage capacity for CO<sub>2</sub>, particularly in saline aquifers where most of the large scale storage potential is predicted to be. The forthcoming results from the UK Storage Appraisal Project, should provide some of this information.

It is important to be able to understand what future energy demands will be. As carbon intensive activities like transportation and heating move towards electric equivalents that are low-carbon at the point of use, there may be a large increase in the energy that needs to be supplied across the UK in the form of electricity. In addition, the day-to-day and seasonal variations in demand for electricity may also change significantly with future variations in climate. These complex issues will need to be understood better to ensure that the energy supply available is sufficient and flexible enough.

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<sup>31</sup> [http://www.decc.gov.uk/en/content/cms/emissions/ccs/demo\\_prog/feed/feed.aspx](http://www.decc.gov.uk/en/content/cms/emissions/ccs/demo_prog/feed/feed.aspx)

Renewable energy technologies present significant challenges when it comes to their connection to national energy networks. Most of the sources of renewables in the UK (wind, waves, tidal, ranges) are distributed geographically, generally not located near large population centres, and may be intermittent. Consequently under a renewables-based system it is more challenging to balance supply with demand. We are pursuing better understanding of:

- how intermittency might affect our electricity network and what steps can be taken to manage it
- energy storage technologies
- electricity demand and supply management

## 2.3 Drive ambitious action on climate change at home and abroad

*Work for international action to tackle climate change, and work with other government departments to ensure that we meet UK carbon budgets efficiently and effectively*

The UK accounts for less than 2 per cent of global greenhouse gas emissions. Therefore, whilst we have an obligation to reduce our emissions to levels which are consistent with preventing dangerous climate change, we must also work with our international partners to secure a global framework that commits all economies to reduce emissions. We must also recognise that targets alone will not deliver emissions reductions, and therefore need to work, nationally and internationally, to develop the clean technologies required to drive the transition to low-carbon. We will:

- Ensure that the UK domestic policy leads the way by meeting five-yearly statutory carbon budgets, with all departments contributing appropriately
- Work with the Department for Business, Innovation and Skills (BIS) to establish a Green Investment Bank to support private investment in clean energy and green technologies
- Within the EU, secure UK climate policy objectives and encourage high ambition
- Help developing countries take action on climate change by providing finance and technological support, including by ensuring the delivery of fast-start funding flows
- Drive progress towards an ambitious global deal on reducing carbon emissions through international negotiations at the UN Framework Convention on Climate Change (UNFCCC)

### 2.3.1 Policy Context

Large reductions in global greenhouse gas emissions will be needed to limit the risk of dangerous climate change. In 2008 the Committee on Climate Change (CCC) advised<sup>32</sup> that an acceptable level of risk was achieved by stabilising greenhouse gas concentrations in the atmosphere at a level that results in no more than a 50% probability that global average temperature increase will exceed 2°C. The Committee's 2010 Report<sup>33</sup> reaffirms this.

In the UK, the recommendations that the CCC made to the Government to achieve a 2°C target are linked to the Climate Change Act. The Act established Carbon Budgets, which set the total quantity of greenhouse gas emissions emitted in the UK over specified time periods<sup>34</sup>

<sup>32</sup> Building a low-carbon economy, the UK's Contribution to tackling climate change – The First Report of the Committee on Climate Change – December 2008. In the report 2°C is a central estimate.

<sup>33</sup> The Fourth Carbon Budget – Reducing emissions through the 2020s – 7 December 2010  
<http://www.theccc.org.uk/reports/fourth-carbon-budget>

<sup>34</sup> Greenhouse gas emissions (CO<sub>2</sub> equivalent) reductions of 35% by 2020 and 80% by 2050

and provide a clear, credible, long-term framework for the move to a low-carbon UK economy. In May 2011 the Government decided the level of the **Fourth Carbon Budget**<sup>35</sup>, covering the period 2023 – 2027. Experts across DECC and other government departments worked together to produce a Carbon Plan that sets out how the government will meet this budget. This was published in Autumn 2011<sup>36</sup>.

The Carbon Plan sets out steps that need to be taken to reduce energy consumption in UK buildings, reduce GHG emissions associated with transport and industry, and significantly increase the supply of low-carbon electricity. The Plan also considers the contribution Agriculture, land use, forestry and waste can make to reducing UK emissions. The Plan demonstrates how the Fourth Carbon Budget can be met, through presenting four scenarios for achieving the necessary emission reductions in the non-traded sector. Emissions in the traded sector (that is emissions associated with electricity production and heavy industry) are capped under the European Union Emissions trading scheme (EU ETS). Two scenarios, both of which reduce emissions in this sector to below this cap, are presented. It is clear from all the scenarios presented that the scale of the challenge is very large indeed (requiring, for example, between 2 and 9 million low-carbon heat installations in UK buildings in total by 2030) but achievable.

The UK's efforts alone will not be sufficient and action to reduce greenhouse gas emissions must take place on a global scale. The UK's approach internationally will focus on:

- deploying UK and EU economic, technical, diplomatic and development assets to influence global political and economic conditions in order to secure action from other countries to limit greenhouse gas emissions;
- helping developing countries to build the climate resilience of their economies and move towards low-carbon growth in the future, including through using international climate finance to support adaptation and mitigation projects in developing countries ; and
- working for a comprehensive global climate change agreement.

Recognising the growing importance and urgency of tackling climate change and its impact on growth and poverty reduction, the Coalition Government has established the International Climate Fund (ICF). The purpose of the ICF is to support international poverty reduction by helping developing countries to adapt to climate change, take up low carbon growth, and tackle deforestation.

The Spending Review 2010/11 allocated £2.9 billion of Official Development Assistance (ODA) to the ICF for the period 2011/12 – 2014/15. The ICF will fully fund the UK's commitment to deliver £1.5 billion Fast Start between 2010-12 and demonstrates the UK's commitment to meeting its fair share of \$100bn of public and private international finance per year by 2020.

The three priorities for the ICF are:

1. Demonstrate that building low carbon, climate resilient growth at scale is feasible and desirable.

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<sup>35</sup> Information about the UK fourth Carbon Budget can be found at [http://www.decc.gov.uk/en/content/cms/news/pn11\\_41/pn11\\_41.aspx](http://www.decc.gov.uk/en/content/cms/news/pn11_41/pn11_41.aspx)

<sup>36</sup> [http://www.decc.gov.uk/en/content/cms/tackling/carbon\\_plan/carbon\\_plan.aspx](http://www.decc.gov.uk/en/content/cms/tackling/carbon_plan/carbon_plan.aspx)

2. Support the negotiations, particularly through providing support for adaptation in poor countries and building an effective international architecture.
3. Recognise that climate change offers real opportunities to drive innovation and new ideas for action, and create new partnerships with the private sector to support low carbon climate resilient growth.

Science and Innovation will play a key role in achieving the transition to a low carbon, climate resilient growth. To help with this, DECC, in partnership with EPSRC, has established a Low Carbon Energy for Development Network ([www.lcedn.com](http://www.lcedn.com)) of leading UK energy institutes. The network will ensure the UK's world-class expertise in sustainable energy solutions helps developing countries achieve their low carbon goals.

### 2.3.2 Science and Innovation programmes

Consistent with the requirements of the United Nations Framework Convention on Climate Change (UNFCCC)<sup>37</sup>, and the Kyoto Protocol<sup>38</sup>, the UK prepares and publishes an annual inventory of UK GHG emissions. DECC is responsible for the annual compilation and improvement of this inventory, which meets our international and domestic reporting obligations. The inventory is also used by both Parliament and the Climate Change Committee to judge whether or not the UK is on track to meet its Carbon Budgets. DECC scientists and statisticians run a programme to verify the accuracy of the inventory, using atmospheric measurements from Mace Head on the west coast of Ireland and from three new UK-based sites, and the inventory is peer reviewed annually by an international team coordinated by the UNFCCC Secretariat. Our inventory work is supplemented by research sponsored by Defra on agricultural emissions. DECC also produces projections of UK non-CO<sub>2</sub> greenhouse gases using methods compatible with the inventory and assumptions that are consistent with DECC's energy projections. These projections are used to understand how UK GHG emissions will evolve in future, and therefore what types of policy intervention will be needed to ensure we meet emissions reduction targets.

UK estimates of greenhouse gas emissions and removals, and projections associated with land-use, land use change and forestry (LULUCF) are included in the UK greenhouse gas inventory. LULUCF is recognised by the UNFCCC and the Kyoto Protocol as being a way of increasing carbon storage and of reducing CO<sub>2</sub> emissions. DECC supports work on international projections of emissions and removals from land use. This work helps support UK input to the UNFCCC negotiations for a post-2012 Climate Change agreement.

As well as supporting international action and work with other government departments on carbon budgets, our work on climate science also provides key support for all of our other main objectives. It has provided the underpinning evidence for our decarbonisation policy agenda, directed our strategy towards low-carbon forms of future electricity generation and continues to provide insight into the risks posed by the changing climate to our energy infrastructure. Crucially, our strength in delivering high quality underpinning climate science means that the UK is able to play leading roles at UNFCCC negotiations and within the Intergovernmental Panel on Climate Change (IPCC).

With Defra, we support climate research and modelling at the Met Office Hadley Centre through its Climate Programme. This programme supports UK policy by delivering world-leading climate research, analysis of climate observations and the development and use of complex numerical climate and earth system models.

<sup>37</sup> <http://unfccc.int/>

<sup>38</sup> Text of the Kyoto protocol can be seen at <http://unfccc.int/resource/docs/convkp/kpeng.html>

The Met Office Hadley Centre's work covers climate analysis and prediction, relevant to the UK's policies on mitigation and adaptation. During 2010-11 this included further development of its state-of-the-art Earth System Model (HadGEM family), work on the impact of possible geo-engineering approaches to tackling climate change, and new work on the attribution of weather and climate extreme events.

A new contract covering the period 2012-15 will provide evidence on how the climate is changing, on establishing where there is a human cause of this change, projecting possible climate futures, assessing the impacts of these on UK energy delivery and on global and regional environmental services and societies, and assessing the risk of dangerous climate change.

The Met Office Hadley Centre also leads a consortium of research institutes in the DECC and Defra funded AVOID programme<sup>39</sup>. AVOID provides policy makers with up-to-the-minute research and critical evidence to understand mitigation pathways that can avoid dangerous climate change and its impacts.

### **UK Greenhouse Gas Inventory Verification**

As described above, for the purposes of verifying the accuracy of the UK Greenhouse Gas Inventory, we fund measurements of greenhouse gas concentrations at Mace Head on the west coast of the Irish Republic. These measurements also contribute to a global network which monitors the global distribution of greenhouse gases, thus improving understanding of their origin, transport and loss. DECC has now expanded its atmospheric observations programme to include three additional sites. A full suite of Kyoto gases including numerous HFCs and additional non-Kyoto halogenated gases and ozone-depleting species will be measured at two of these, while the key gases CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O will be measured at all four sites. This data will be interpreted to produce northern hemisphere baseline concentrations and Devolved Administration level emission estimates.

### **Monitoring, Reporting and Verification**

Effective Measurement, Reporting and Verification (MRV) is central to a meaningful global climate change agreement. Such a regime should show actual emissions levels country by country. It relates to how much action developing and developed countries take, and the amount of financial, technological and capacity building support that developed countries provide. DECC is an active participant in the UNFCCC negotiations on MRV and is involved with bilateral technical cooperation including with Brazil and China. We are represented on the Bureau of the IPCC programme that develops emissions inventory guidelines that are used by developing and developed countries in reporting to the UNFCCC and make a significant scientific and technical contribution to this work.

### **Global climate observing systems**

We need observations of the climate system (land, atmosphere and oceans) for many different reasons; to understand how climate is changing and affecting societies and economies, to understand processes, to validate and improve models and to initialise decadal predictions. We fund, or co-fund, a number of observational programmes where they are crucial to support other parts of our research programme.

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<sup>39</sup> <http://www.avoid.uk.net/>

### The AVOID programme

In 2009, the UK initiated the Avoiding Dangerous Climate Change (AVOID) programme, jointly funded by DECC and Defra. It was designed to provide targeted, policy-relevant evidence to inform strategies for avoiding dangerous climate change, through original research and by synthesising current and new knowledge in science, socio-economic science and technology development. The programme is delivered by a consortium of UK research institutes led by the Met Office Hadley Centre and including the Walker Institute, the Tyndall Centre and the Grantham Institute for Climate Change at Imperial College. It can also draw on a wide range of research institutes and expertise under the AVOID Network. The AVOID programme seeks to address three core questions:

1. What levels of climate change are potentially dangerous?
2. What emissions pathways will avoid *dangerous* climate change?
3. What is the technical and economic feasibility of such pathways?

In its first phase, AVOID provided the scientific evidence to inform and support the UK delegation ahead of the 15<sup>th</sup> Conference of Parties to the UNFCCC (Copenhagen, 2009). The scientific analysis focussed on the emissions pathways associated with limiting global average temperature rise to 2°C, the physical and economic impacts of mitigation action, and the costs associated with delaying action.

In other work, when the National Audit Office conducted an assessment of DECC's performance in 2009, an AVOID review of available greenhouse gas emissions inventories helped raise DECC's rating in this category to the highest possible level.

More recently, AVOID produced a detailed scientific assessment of the implications of the 2020 target pledges received under the Copenhagen Accord with respect to the 2°C temperature limit. This work was released in March 2010 and is available from the AVOID website.

Over the next three years, the programme will continue to provide core scientific research to improve our understanding of dangerous climate change in relation to the three core questions. It will also grow to work alongside research institutes from across the globe and engage with international scientific bodies.

- The ARGO programme measures ocean salinity, velocity and temperature using free floating buoys.
- Satellite based programmes AATSR (Advanced Along-track Scanning Radiometer) and JASON-3, both partly supported by the Department, measure sea surface temperature and sea level respectively.



ARGO Float – image courtesy of Sabrina Speich

A DECC Earth Observations strategy is in preparation. It will complement this Science and Innovation Strategy, and set out in more detail the observations required and how they are to be secured. This involves working with many other organisations, at both the national and international level, and is particularly important at a time of financial constraints when existing arrangements and budgets are under pressure.

### 2.3.3 Long-term strategy and Evidence needs

Climate change presents a unique set of policy challenges because of its global scope, its long-term implications and the scientific uncertainty concerning its scale and nature. A key policy challenge is to agree internationally actions required now and in the future to reduce greenhouse gas emissions sufficiently to avoid dangerous levels of climate change. Also, whilst the main assessment of the problem is robust, continuing uncertainty over the details of climate change and the need for better assessment of the risks, requires UK policy to continue to be informed by world-class science and near policy research. This includes:

- Monitoring current conditions and changes to support detection and attribution;
- Furthering understanding of future UK climate change and impacts;
- Commissioning and providing independent advice and critiquing new results to inform policy;
- Maintaining UK support for, and input into, the Intergovernmental Panel on Climate Change review process.

DECC's evidence needs are fully consistent with priorities that were identified by the Beddington Review (2010)<sup>40</sup>. This considered HMG needs for climate science advice now and over the next decade and stressed that a key underpinning requirement for many HMG needs is to understand and quantify better and reduce uncertainties associated with climate change projections. The review noted the following needs for climate science evidence in the context of reducing UK emissions and achieving global action for mitigation:

- improved understanding of global climate change, including climate sensitivity and impacts under different emission scenarios;
- better understanding and quantification of emissions from sources and sectors to develop and evaluate domestic and international policies;

- improved understanding of the risks of abrupt and /or irreversible climate change and better evaluation of possible geo-engineering options;
- improved projections of weather and climate for marine and land-based renewable energy;

and for adaptation:

- better regionally-specific information on changes in mean weather and variability (including frequency, severity and location of extreme events);
- improved understanding of single and multi-sector impacts in the UK;
- continued need for detection and attribution of man-made climate change.

There is a need to understand and quantify better uncertainty associated with global and UK climate projections to facilitate a risk-based approach to decision-making. This requires *ensemble modelling*, which helps understand uncertainty ranges, and consequently increased support for high performance computing.

A number of strategic needs underpin many of the requirements outlined above. In particular, current projections of regional and local climate change are characterised by high levels of uncertainty, which make it challenging to develop appropriate policies. Thus, there is a fundamental requirement to reduce the uncertainties associated with projections. This need is particularly acute at regional to local scales, on seasonal to decadal timescales, and for understanding changes in extreme and hazardous weather. These are most commonly needed to support decision making, both in the UK and internationally.

Finally, DECC recognises an increasing need for probabilistic assessments of dangerous climate change events, thresholds or tipping points under plausible, agreed and evolving emission pathways; and given specific emissions pathways, identification of thresholds for and probability of, particular events occurring. Monitoring and predicting when the climate system might close in on a particular threshold or event, would facilitate the development of early warning systems for dangerous or catastrophic climate change.

## 2.4 Manage our energy legacy responsibly and cost-effectively

*Ensure public safety and value for money in the way we manage our nuclear, coal and other energy liabilities*

There are currently ten nuclear power stations in England, Scotland and Wales, providing around 18% of the electricity consumed in the UK, about 6% of total UK primary energy supplies. On the basis of current plans and because of aging all but one of the existing nuclear power stations will have shut by 2023. DECC is the lead government department responsible for the development and implementation of nuclear policy, covering current and future nuclear installations in the UK as well as dealing with the legacy of nuclear generation. DECC is also responsible for ensuring the oil and gas production in the UK is safe, and that environmental risks associated with this activity are understood and managed. Therefore we will :

- work with the Shareholder Executive in sponsoring the Nuclear Decommissioning Authority (NDA) to deliver its mission cost-effectively;

<sup>40</sup> <http://www.bis.gov.uk/assets/bispartners/goscience/docs/r/10-1290-review-of-climate-science-advice.pdf>

- develop and implement solutions for the long-term management of higher activity radioactive waste through geological disposal, placing waste within engineered facilities deep inside a suitable rock formation, and develop policy on future management of UK's civil plutonium;
- further improve the security of civil nuclear sites and materials;
- review environmental regulation of oil and gas exploration in the light of the Gulf of Mexico spill.

### 2.4.1 Policy Context

The Nuclear Decommissioning Authority (NDA) is a DECC sponsored Non-Departmental Public Body created under the Energy Act (2004). Its core objective is to ensure the historic civil public sector nuclear legacy sites are decommissioned safely, securely, cost effectively and in ways that protect the environment. The NDA is also required to:

- Operate existing commercial activities and meet current contracts, using revenues to offset spend on decommissioning; and
- Scrutinise the site decommissioning plans of British Energy.

Since October 2006 it has also been the UK body responsible for implementing geological disposal of higher activity radioactive waste and delivering the UK Government's integrated nuclear waste policy. The NDA assumed responsibility for the sites previously owned by British Nuclear Fuels plc (BNFL) and the United Kingdom Atomic Energy Authority (UKAEA).

The UK's civil nuclear legacy is a major public liability and represents one of the largest and most important environmental restoration programme in Europe. The NDA's mission is to deliver safe, sustainable and publicly acceptable solutions to this challenge, driving substantial change to improve delivery using competition for contracts to bring in world-class expertise to drive innovation, improve clean up and deliver value for money. DECC uses evidence produced by the NDA when determining policy direction in nuclear waste management, and has also used evidence from the NDA to inform our thinking on plutonium disposal options.

DECC is also responsible, under the 1994 Coal Industry Act, for the liabilities of the former nationalised coal industry managing several compensation and concession schemes.

### 2.4.2 Science and Innovation programmes

The work of the NDA is supported by a large body of evidence, provided by an internal research programme and through the work of the Site License Companies SLCs that operate at its sites. It has three main areas of research:

- geological disposal - looking at the underpinning science and technology for the disposal of UK higher activity wastes and materials;
- nuclear materials management - research into the management of plutonium, uranium and spent fuels;
- decommissioning – strategic R&D to inform policy and strategy, research to support the development and retention of a highly skilled workforce in the UK and close work with the National Nuclear Laboratory.

Further information about the NDA research programme is available online.<sup>41</sup>

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<sup>41</sup> [www.nda.gov.uk/research](http://www.nda.gov.uk/research)

### **2.4.3 Long-term strategy and Evidence needs**

The safe, long term disposal of nuclear waste in a deep geological formation will be a huge technical challenge. The requirements for the facility will need to be considered with those who are determining the future of the nuclear power industry in the UK to ensure that it is suitable. Evidence will be needed on many aspects of the project, including detailed assessments of the geology of potential sites and modelling on the degradation of materials over long timescales. The NDA are responsible for the technical aspects of this programme.

# Section 3 – Approach to Evidence

## 3.1 Governance and quality assurance

The Department needs to have access to excellent scientific and technical evidence so that it can make decisions on climate change and energy policy. As already shown in **Figure 1**, we obtain our evidence and analysis from many sources. Given this range of sources, it is essential that we are able to quality assure these key inputs to our policy making process. We are adopting new processes and systems that are designed to ensure the evidence we utilise is of the highest quality, delivers the necessary information to support policy and represents good value for money for the taxpayer through :

- Internal challenge and advice to Policy groups by the Chief Scientific Advisor
- Evidence Panel
- External challenge and advice to Policy groups by expert Scientific Advisory Groups
- Policy evaluation
- Improving the commissioning, monitoring and publishing of research
- Knowledge Management
- Engagement with Research Councils at a strategic level
- Public engagement
- Horizon Scanning

### 3.1.1 Internal challenge and advice to policy groups by the Chief Scientific Advisor

The Chief Scientific Advisor works closely with other analytical professions, policy programmes and Ministers to ensure that our policies and operations are underpinned by the best science and engineering advice available. He has opportunities to advise and influence throughout the policy cycle (see Figure 3) by means of the different boards and panels he sits on:

#### The Evidence Panel

The CSA and Chief Economist co-chair this panel to help ensure that new policies are based on good quality evidence and that the evidence needs of the policy programme are fully considered and resourced appropriately. More information on the evidence Panel is given below.

#### The Approvals Committee

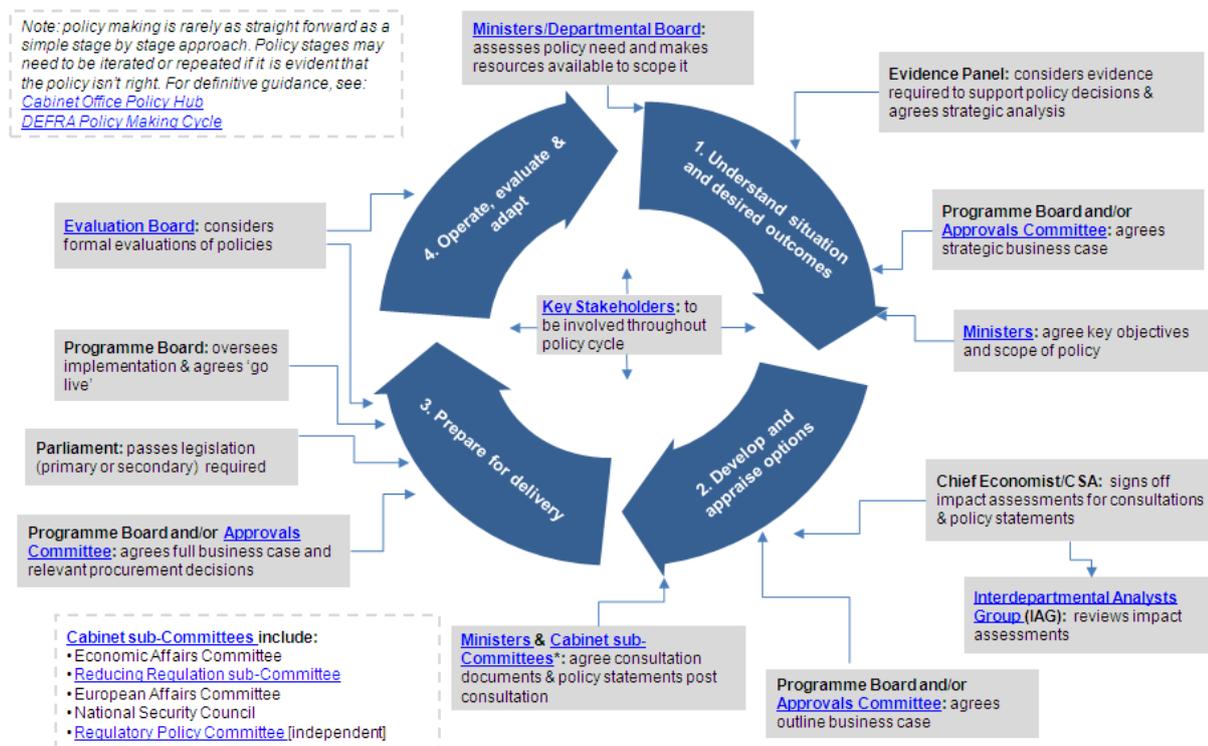
The purpose of the Approvals Committee is to ensure that DECC's major projects and programmes are deliverable and affordable with adequate planning, resourcing and governance structures. It does this by considering the business cases, financial impacts, costs and value for money of major projects and programmes to ensure they are fit for purpose and, where appropriate, scrutinising their delivery plans. The CSA sits on the Approvals Committee to ensure scientific and technical scrutiny of DECC's projects and programmes.

## The Evaluation Board

The purpose of the DECC Evaluation Board is to oversee and steer the Department's work on measuring the actual effects of policies. It will identify, prioritise and steer evaluation and related data collection across DECC, ensuring consistent, usable and useful evidence across different streams of work.

## Impact Assessment sign-off

Impact Assessments (IAs) are generally required for all UK Government interventions of a regulatory nature that affect the private sector, the third sector and/or public services. Where the impact assessment considers scientific or technical subjects or utilises scientific analysis, the approval of the CSA is required before the policy can proceed.



**Figure 3 : The Policy Cycle in DECC**

### 3.1.2 Evidence Panel

We have established an evidence panel co-chaired by the CSA and Chief Economist, in order to:

- ensure the development of a coordinated and high quality evidence base to inform our policy and strategy;
- advise policy teams on resources and expertise available to them and support them in developing our evidence base;
- advise on the efficient use of our research and consultancy budgets; and
- ensure effective and timely combined use by ourselves and our sponsored bodies of scientific, economic, statistical and social science evidence.

The Evidence Panel is intended to help progress policies through the policy cycle (see **Figure 3**). Although the Evidence Panel is shown to engage at the start of the policy cycle, its role is intended to be iterative throughout the cycle. The Panel will assist policy teams with understanding their evidence needs, and improve the way technical and scientific knowledge is shared across DECC.

The panel has been meeting since June 2010 and has considered and provided scrutiny of a wide range of topics, including:

- the evidence underlying analysis on the best use of biomass;
- the evidence on drivers of household energy consumption and the abatement opportunities available in the non-domestic sector;
- the proposed methodology for accrediting installers and advisors for the Green Deal;
- the research and evidence collection being carried out by the Carbon Trust and Energy Savings Trust; and
- the planned approach for incorporating costs into the 2050 pathways calculator.

In order to embed the consideration of scientific and technical issues at all levels in the Department the **network of science and technology leads**, comprising DECC staff members from each departmental programme, exists to exchange ideas and discuss scientific and technical evidence needs and how to address these. This will improve communication across DECC, offer internal peer-review of the way we gather and use evidence and give the opportunity to share and demonstrate best practice.

### 3.1.3 External challenge and advice to policy groups by expert Scientific Advisory Groups

As well as internal challenge and advice, there are a number of groups and organizations which provide scientific, technical and other expert advice and challenge to DECC. These include: the Committee on Climate Change, the Science Advisory Group (SAG) and the Committee on Radioactive Waste Management.

#### Committee on Climate Change

The Committee on Climate Change (CCC) is an independent body established under the Climate Change Act which advises Government on emissions targets and reports to Parliament on progress made in reducing emissions. It also conducts independent research and analysis into climate change. Their reports are published at [www.theccc.org.uk](http://www.theccc.org.uk) and include:

- Annual reports to parliament on the progress made in reducing emissions and meeting carbon budgets (most recently in June 2011);
- The Renewable Energy Review (May 2011)- *advice on the potential for renewable energy development in the UK*; and
- The Fourth Carbon Budget – Reducing emissions through the 2020's (December 2010) – *The CCC advice on the level of the fourth carbon budget, covering the years 2023 to 2027.*

#### Science Advisory Council

We plan to establish a Science Advisory Council (SAC) to provide independent scientific advice to the Department and the Chief Scientific Advisor. The SAC will comprise top scientists, engineers and social scientists from outside government that will provide independent advice to

DECC and the CSA on scientific issues important to us. In the interim, we have established an ad-hoc Science Advisory Group (SAG). The first meeting of the group was in July 2010 and it has met quarterly since. Up-to-date information on the SAG, including terms of reference and meeting minutes can be found on the DECC website.

### **Committee on Radioactive Waste Management**

The role of the Committee on Radioactive Waste Management is to provide independent scrutiny and advice to the Government on the long term management, including storage and disposal, of radioactive waste. Within this role its main task is to provide independent scrutiny on proposals, plans and programmes to deliver geological disposal, together with robust interim storage, as the long term management option for the UK's higher activity wastes.

#### **3.1.4 Evaluating our policies**

Evaluation is built into our policies and programmes, and considered and planned at an early stage to ensure there is appropriate ownership, and adequate resources allocated to this task. Prioritisation of DECC's policies and programmes by the Evaluation Board ensures evaluation efforts and resources are appropriately focused on areas where there is greatest need for evaluation to happen.

#### **3.1.5 Commissioning, monitoring and publishing research**

We must ensure that the research projects we commission deliver high quality outcomes and value for money. This requires attention at all stages of a projects life, from initiation to its eventual closure. At the early stages developing and communicating a clear and deliverable project specification is an important factor, but the selection of appropriate, high quality delivery partners and contractors is also vital. To help ensure quality and reduce duplication all business cases for research contracts with scientific or technical elements now require approval from the Chief Scientific Advisor before being let.

We are reviewing the training and guidance on research procurement that is available to staff throughout DECC to see where improvements can be made. New guidance will emphasise the need to consider post completion evaluation within project plans, specifying the need for independent review and value for money assessment.

Further to the work on procurement within DECC, the Government has launched a new procurement web-portal<sup>42</sup> to simplify the procurement process and to encourage more bids for work.

We will publish on our website<sup>43</sup> all research and policy evaluation reports that we commission except in those small number of cases where security or commercial confidentiality issues arise. Where possible we will also actively encourage our research contractors to publish work supported by the Department in peer reviewed journals. This will help to ensure that the Department's evidence base in key areas of policy is transparent, subject to external scrutiny, and available as part of the wider body of knowledge on climate change and energy. We also encourage our in-house scientists and engineers to publish their analyses which underpin the Department's policies on climate change and energy. This helps ensure that our analyses are open to scrutiny and there is full transparency in our decision making.

<sup>42</sup> <http://www.contractsfinder.co.uk>

<sup>43</sup> <http://www.decc.gov.uk/publications/>

### 3.1.6 Knowledge Management

To deliver the challenging objectives set out above we must use the information and knowledge that exists within DECC as efficiently and effectively as possible. Good knowledge management is key to enabling a consistent and high quality evidence base. In a large organisation like DECC key challenges include:

- ensuring everyone is aware of and can easily access the knowledge available;
- retaining the knowledge of staff and specialists;
- avoiding duplication of research and promoting collaboration between teams where appropriate.

A new electronic records storage system has been introduced in DECC, allowing all corporate records to be stored and accessed centrally. This system allows all non-sensitive information to be shared and searched easily. Further to this we are in the process of developing and trialling a system that will gather resources around particular topic areas into one place, enabling both experienced and novice analysts to quickly access the documents they require and gain a comprehensive overview of their area of interest. This system is expected to be operational in 2012.

### 3.1.7 Engagement with Research Councils at a strategic level

The programmes supported by the Research Councils are an important part of our evidence base, for example, the RCUK Energy Programme, the Ocean Acidification Programme and the Living With Environmental Change Programme. We will engage with these and other programmes at a strategic level to ensure that the projects specifications meet our needs. We are in the process of establishing concordats between DECC and each of the Research Councils to formalise our relationships with these bodies.

### 3.1.8 Public engagement

Meeting the demanding Carbon reduction targets set in the Climate Change Act will require large changes to many aspects of life in the UK. The way we use electricity in our homes and transportation are two examples, but there may also be significant alterations to the appearance of our landscape. There will be many choices to be made during this process and it is important that DECC engages with the public well to get their ideas as well as opinions on how we might best deliver our objectives. Initiatives like the 2050 pathways challenge, where the public have been asked to show us what their preferences are for the future energy system, are good examples of our willingness to engage on our biggest challenges. In addition to gathering opinions, the 2050 pathways project also sought scientific contributions to refine the assumptions that we had used in our modelling.

Communities may be able to play a significant role in reducing carbon emissions at a local level and we are working to understand how through the **Low-Carbon Communities Challenge** (LCCC). By offering financial and advisory support to 22 test-bed communities to help with the installation of measures such as solar panels, hydro turbines and insulation, we will test different delivery packages as well as capture the learning from the experience. This should lead to improved understanding of the role of communities as well as of the efficacy of different initiatives.

### 3.1.9 Horizon scanning

Horizon scanning for scientific and technical matters has been identified as an area in DECC which needs to be strengthened. We are working with partners in Defra and the wider Living With Environmental Change (LWEC) network to develop this capability and a proposal has been made that is being considered. It will:

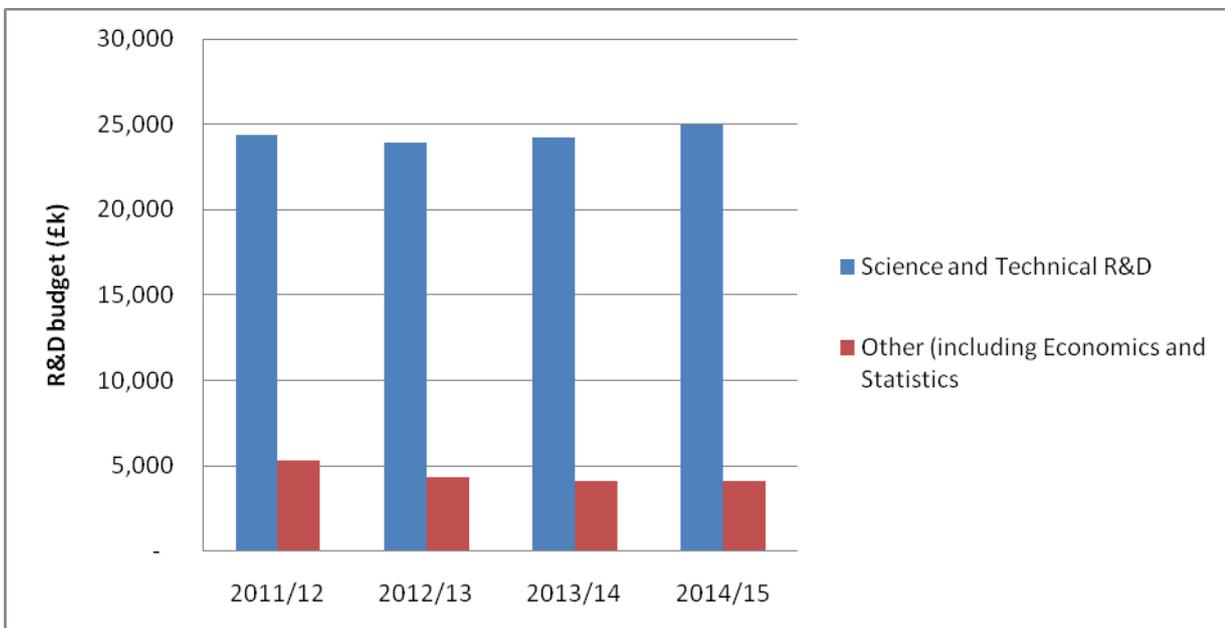
- develop a programme of regular environmental horizon scanning to identify and disseminate emerging issues on the short, medium and long term horizons;
- integrate risk analysis methods and techniques to assess and prioritise the importance/likelihood and impact of emerging issues identified;
- develop a programme of larger scale futures (foresight) studies (e.g. scenario building) to investigate a range of plausible futures and their implications for high priority issues;
- build wider capacity to assess future risks and opportunities, through a range of up-skilling training courses and knowledge exchange activities and materials.

Future Evidence Strategy documents will report on the progress and outcomes of this initiative.

## 3.2 Resources

### 3.2.1 Budgets

We engage with and support scientific and technical projects at all stages of Research, Development, Demonstration and Deployment. DECC's innovation funding, focused on low carbon technologies at their development and demonstration stages is worth over £150m between 2011 – 2015. The spending profile, which is subject to change, will rise from circa £22m in 2011/12 to between £40-50m in the 3 subsequent years. Announcements have already been made relating to future support for offshore wind, marine and low carbon buildings.



**Figure 4 : DECC R&D budgets to 2014/15**

The total R&D budget is split between teams within DECC, who have responsibility for using those funds to deliver the evidence base they need. A function of the Science and Innovation Group in DECC is to help coordinate research programmes outside of its direct financial control, providing advice and guidance at an early stage, during the development of business and delivery plans.

In addition to the ca. £24 million per year allocated to scientific research in support of policy development, DECC has also allocated £200 million to support the development and demonstration of low-carbon technologies over CSR period (April 2011 – March 2015). This includes up to £60 million for the development of offshore wind manufacturing at UK ports

### 3.2.2 Science and Engineering specialists in DECC

To be effective we need to have within the Department:

- An 'intelligent customer' capability to commission and interpret research results for use in policy development;
- A 'knowledge broker' capability to bring external science, engineering and technical expertise where needed to bear on climate and energy policies;
- Increased scientific and technical understanding and capability throughout non-specialist positions.

The Capability Review in 2009<sup>44</sup> highlighted a need for us to increase our capability in respect the social sciences. Understanding how people and communities might respond to things like the introduction of new energy technologies, electric vehicles or insulation programmes is crucial to ensuring that our policies can be successful. A customer insight team has been formed and is recruiting new members of staff, focussing on a mix of policy-specific work, cross-cutting strategic projects and capacity building. The three headline priority work areas for the team in 2011/12 are:

- continuing to support DECC's customer facing policies and other key delivery and policy areas;
- supporting the Departments work on energy efficiency strategy through a strategic insight project on domestic energy efficiency behaviours, the development of DECC's non-domestic social evidence base and a public attitudes monitor
- building Customer Insight capacity across DECC through the development of a customer insight toolkit and delivering training sessions on the toolkit and the existing behavioural models tool.

In addition to the staff in the customer insight team, DECC has recruited a social scientist into a central role to develop a medium and long term social science research strategy for DECC.

Engineering was also identified as a capability which DECC needs to enhance. The skills of engineers will be vital as DECC works to deliver new renewable energy generation capacity and transmission infrastructure. We are currently developing our in-house capability by recruiting engineers with backgrounds in Mechanical, Electrical, Software/communications, Nuclear, Materials, Chemical and Systems Engineering to provide expert technical advice and support to policy delivery teams and to the Chief Scientific Advisor. Several of these engineers will be specifically located within their relevant policy teams to ensure as close a working relationship as possible. To oversee this new area in DECC is also be appointing a Head of Engineering.

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<sup>44</sup> <http://www.civilservice.gov.uk/wp-content/uploads/2011/09/DECC-phase2-Dec2009.pdf>

## Intelligent customer role

The Science and Innovation Group contains experts in a range of scientific and technical disciplines relevant to our business. Acting as an intelligent customer they advise members of the Department on how best to formulate specifications for new research projects. Once projects are completed, the Group has the in depth knowledge to be able to help analyse the implications of the research findings. It is important to ensure that the staff fulfilling this function are up-to-date with the latest developments in their fields and are engaging with their peers across industry and academia.

To do this we actively encourage secondments and placements of staff into and out of the Department. One particular success has been the DECC/Research Council **Science Policy Fellowship Scheme**, which has seen specialists from academia in climate science, engineering and social science working in DECC and sharing their expertise and experience whilst gaining for themselves an understanding of how central government operates. Successful outcomes from this scheme have included the provision of expert advice on the transport sector for input into the 2050 pathways work and Carbon Budgets analysis, increased understanding of how social sciences can play a positive role in our future policy development and increased interactions on technical matters between DECC, other government departments, academia and the Research Councils.

## Knowledge broker role

Our scientists and engineers have an important role as knowledge brokers acting as a bridge between policy makers and academic communities. Our scientists need to be well-informed about research in their respective fields and be able to provide a consolidated view of the current state of knowledge. The flow of knowledge is necessarily two-way as an important role for our scientists and engineers is also to communicate the Department's evidence needs to the wider academic community.

## Increasing the scientific and technical competence of DECC staff

Scientific and technical literacy is crucial if we are to develop the right kind of policies needed to respond effectively to the climate change and energy challenge. We are increasing the scientific and technical literacy of our staff by a number of means. First, we have in place a highly regarded DECC School, where staff can gain recognised diplomas following the successful completion of courses to raise their understanding of the scientific, technical and policy background to climate change and energy. In addition, we hold a regular series of DECC-Lite seminars on topics relevant to the Department's remit. The invited speakers include DECC staff and leading academics. The network of scientific and technical leads that has been set up in the Department is also seeking to embed proficiency throughout. Finally, our Chief Scientific Advisor has instituted his own series of science seminars, which are open to all DECC staff.

The central Science and Innovation Group is currently strengthening its staff mix to oversee and quality-assure the evidence-gathering-processes underlying DECC's policy work (in collaboration with DECC's economists); to put in place an effective knowledge-management system for DECC's evidence, and to provide additional in-house expertise in engineering.

# Section 4 - Implementing the Strategy

## 4.1 Risk management

The initiatives in this strategy and the creation of a future strategy are subject to some risks. These are outlined below alongside the action we will be taking to minimise them.

- *Staff turnover* – There is a risk that outcomes from this strategy and the delivery of its future revisions will be delayed or not delivered if the staff responsible for it move on to new positions. To mitigate against this risk future versions of the strategy will be led by a group and be included within the objectives of a team to ensure that responsibility is always passed on. We are also developing new knowledge management systems that should enable better transfer of knowledge between staff when they hand over their responsibilities.
- *Delays to the formation of the Strategy and Evidence Group* – The risk is that future strategies may be delayed and that existing processes may not function well in the transition period. To mitigate against this a SEG creation team has been established, with experts across all disciplines working to deliver an effective unit.
- *Rapid change to policy priorities* – There is a risk that changes to Government policy would invalidate aspects of the science and innovation strategy, particularly in the case of DECC's stated evidence needs. To mitigate against this it is important that evidence needs are reviewed and published on a regular basis and that Horizon scanning activities are properly resourced.

DECC recognises the consequences of failing to ensure policy is supported by appropriate evidence, and the risk that a lack of appropriate expert capacity (this includes legal, commercial and other types of expertise, as well as scientific and economic expertise) poses to delivery. The Baseline Capability Review of DECC, published in 2009<sup>45</sup>, highlighted the risks posed by lack of appropriate skills. As described in Section 3.2.2 Science and Engineering specialists in DECC, the Department is recruiting a number of Social Scientists and Engineers in order to significantly strengthen our capacity in these areas. Furthermore, these specialists have been tasked with improving the quality of the departments relationship with technical experts across industry and academia to ensure that outside expert capacity can be brought to bear more rapidly and more effectively on the department's problems, when internal capacity is insufficient.

We have also identified risks to delivery of our innovation programme. In particular the Research Councils Energy Programme is fundamental. It funds at technology-readiness levels 1 – 2 and into level 3, linking to the TSB. DECC, through the CSA, have worked with the programme to ensure it supports appropriate right technology areas for 2020 and beyond.

The BBSRC Sustainable Bioenergy Centre, and Energy Crop Scheme run by Natural England, are of high importance, as they carries out grass roots research into generating fuel from energy crops. This area has been identified as a key area of innovation requirement in the Bioenergy technology needs assessment.

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<sup>45</sup> <http://www.civilservice.gov.uk/wp-content/uploads/2011/09/DECC-phase2-Dec2009.pdf>

The ETI are carrying out work of direct relevance to DECC in a wide-range of areas (including the carbon impacts of land use change, engineering studies of biomass to power with CCS, biomass value chain analysis, waste to power demo and more) which is of high value to DECC and it is important this work is completed. The ETI's Energy System Modelling Environment (ESME) is a model that focuses on a whole system analysis, including interactions between power, heat, transport and infrastructure. It considers the performance, costs and rates of installation for new technologies. Since its release to members, the ESME model has been used to help inform the DECC Technology Innovation Needs Assessments (TINAs) and the Carbon Plan. Some of the other ETI programmes of work have also been used to help inform the TINAs. Loss of ETI work in these areas would hinder our ability to deliver energy innovation in the UK.

DECC successfully managed the risk of impact on innovation posed by closure of the regional development authorities (RDAs) through working closely with BIS to ensure options were considered to ensure continued support the flagship projects, such as marine testing facilities, and that low carbon projects were supported through the Regional Growth Fund (RGF).

## 4.2 Monitoring and updating the strategy

Ultimately the responsibility for ensuring that the outcomes described in this strategy are delivered rests with the DECC Chief Scientific Advisor, supported by the Director of Science and Innovation, and DECC Head of Science. An Innovation Programme Board, and a Science Programme Board, both with representation from across DECC, have been established to ensure delivery of the Innovation and Science Programmes, and to monitor progress against milestones and deliverables.

At the time of publication the approach to evidence in DECC is in a transitional period with the formation of a "Strategy and Evidence Group" (SEG) to bring together those with responsibility for Economics, Science, Engineering and Statistics into a single unit. Formation of SEG significantly strengthens the Department by bringing truly multidisciplinary analysis to bear on all of our policies and programmes.

We propose to update this strategy and produce a comprehensive DECC evidence strategy, that will cover Science, Engineering, Statistics and Social Sciences (including economics). This will include:

- more detailed breakdowns of specific evidence needs across all policies and programmes
- a detailed medium and long-term view of the evidence and analysis required to deliver our 2050 vision, anticipating challenges that will arise in the future as we move towards a low-carbon economy
- improved arrangements for engaging with researchers and utilising existing national and international knowledge/experience

This Evidence strategy will be published in 2013 and will cover the period until 2015.

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