EXPLANATORY MEMORANDUM TO
THE ELECTRICTY AND GAS (CARBON EMISSIONS REDUCTION) ORDER 2008

2008 No.

1. This explanatory memorandum has been prepared by the Department for Environment, Food and Rural Affairs and is laid before Parliament for approval of each House by Command of Her Majesty.

2. Description

2.1 The Electricity and Gas (Carbon Emissions Reduction) Order 2008 (the draft Order) would place on electricity and gas suppliers an overall target for reduction in carbon emissions in the household sector. It requires the Gas and Electricity Markets Authority (known as Ofgem) to determine the carbon emissions reduction obligation for each supplier. Ofgem must also determine whether measures proposed by suppliers can be used to meet their targets and what reductions in carbon emissions should be attributed to them. Ofgem is also responsible for enforcement.

3. Matters of interest to the JCSI

3.1 The draft Order establishes a carbon emissions reduction target (set in terms of lifetime tonnes of carbon dioxide) for certain electricity or gas suppliers for the period 1 April 2008 to 31 March 2011. This is a broad successor to the energy efficiency target imposed under the Electricity and Gas (Energy Efficiency Obligations) Order 2004 (SI 2004 No.3392) (the 2004 Order) for the period 1 April 2005 to 31 March 2008, known as the Energy Efficiency Commitment.

3.2 The draft Order is made under the same statutory powers as the 2004 Order and is intended to achieve broadly similar effects. Those powers have, however, been amended since the 2004 Order was made (see under paragraph 4.1 below) and the draft Order does not follow the drafting of the 2004 Order.

4. Legislative background

4.1 The draft Order is made under powers in the Gas Act 1986, the Electricity Act 1989 and the Utilities Act 2000. These powers were amended by the Climate Change and Sustainable Energy Act 2006, to enable the Secretary of State to set an overall carbon emissions reduction target for the promotion of any of the following:

(a) measures to improve energy efficiency (as under the current Energy Efficiency Commitment)

(b) if the Order so provides –

(i) microgeneration measures

(ii) any other measures for increasing the amount of electricity generated or heat produced using low-emissions sources or technologies

(iii) measures for reducing the consumption of energy.

4.2 The draft Order extends the scope of the current Energy Efficiency Commitment by providing that a supplier must achieve its carbon emissions reduction obligation by promotion of measures for the following purposes:

- achieving improvements in energy efficiency
- increasing the amount of electricity generated or heat produced by microgeneration
- increasing the amount of heat produced by any plant which relies wholly or mainly on wood
- reducing energy consumption.

4.3 Under the draft Order, energy suppliers are required to achieve at least 40% of their carbon emissions reduction obligation by promoting measures to the priority group, that is those in receipt of at least one of the benefits or tax credits listed in Schedule 2 to the Order, or to those who are aged 70 or over. This is known as the priority group obligation.

5. Extent

5.1 This instrument applies to Great Britain.

6. European Convention of Human Rights

6.1 Phil Woolas, Minister of State at the Department for Environment, Food and Rural Affairs, has made the following statement regarding Human Rights:

In my view the provisions of the draft Electricity and Gas (Carbon Emissions Reduction) Order 2008 are compatible with the Convention rights.

7. Policy Background

7.1 The purpose of the carbon emissions reduction target (CERT) in promoting reductions in carbon emissions is to help energy consumers in the household sector to reduce the carbon footprint of their homes by using energy more efficiently and using energy from microgeneration sources. In doing so, they will reduce their fuel costs and/or enjoy greater comfort.

7.2 Through achieving carbon savings, the primary aim is to make a significant contribution to the UK's legally binding target under the Kyoto protocol to cut greenhouse gas emissions by 12.5% below 1990 levels by 2008-2012 and its domestic goal to cut emissions of carbon dioxide by 20% and 60% below 1990 levels by 2010 and 2050 respectively.

7.3 CERT will build on the current Energy Efficiency Commitment and require energy suppliers to broadly double the level of their activity. The Order requires CERT to deliver overall lifetime carbon dioxide savings of 154 $MtCO_2$ – equivalent to annual net savings of 4.2 $MtCO_2$ by 2010 – and will stimulate about £2.8bn of investment by energy suppliers in promoting carbon reduction measures.

7.4 In providing particular help to low-income consumers and the elderly, it is expected that the carbon emissions reduction target will contribute to the alleviation of fuel poverty. Overall around £1.5bn is expected to be directed at the priority group.

7.5 The draft Order allows suppliers to achieve a proportion of their priority group obligation by directing specified measures to low-income consumers in the private housing sector. Within this group, ground source heat pumps may be promoted to households off the gas grid and solid wall insulation to all households. Under this option, measures more likely than other carbon-saving measures to remove households from fuel poverty will be directed at those households.

7.6 The draft Order encourages activity by suppliers to promote innovative measures or approaches. Under the provision for demonstration action, they will be able to count towards their obligation innovative measures to which accurate carbon savings cannot yet be determined. Ofgem will accredit these measures on the basis of the translation factor included in the draft Order. There will also be a route for innovative measures for which carbon savings can be determined, known as market transformation action. As an incentive to the promotion of those measures, Ofgem will attribute to them an additional 50% of carbon savings.

7.7 In order to limit the loss of carbon savings, there is a ring-fence for demonstration and market transformation actions of no more than 6% of a supplier's obligation. However, where a supplier promotes microgeneration measures as part of its market transformation action and microgeneration accounts for at least 2% of a supplier's obligation, the overall ring-fence is increased to 8%. This is intended to provide encouragement to the promotion of the installation of microgeneration.

7.8 There has been extensive consultation on the carbon emissions reduction target, both informal and formal. The Government has engaged with a wide range of stakeholders, including electricity and gas suppliers, representatives of energy efficiency industries, local authorities and other representative bodies and organisations with an interest in energy efficiency, carbon reduction, fuel poverty and the environment. In July 2006 the Government issued an Initial Consultation on the Energy Efficiency Commitment 2008-11 (the former name for the carbon emissions reduction target) to solicit early views and inform the statutory consultation.

7.9 The statutory consultation "Carbon Emissions Reduction Target April 2008 to March 2011" was published in May 2007 and concluded on 15 August 2007. A brief summary of the responses is contained in the Impact Assessment attached to this Memorandum.

7.10 The provisions in the draft Order take account of the comments received throughout the whole of the consultation process, particularly the statutory consultation in May 2007. They also take account of the latest information on the costs of carbon saving measures and other parameters that are likely to influence capacity constraints and suppliers' costs in meeting their CERT obligations, including information about delivery of the current Energy Efficiency Commitment.

8. Impact

8.1 An Impact Assessment is attached to this Memorandum.

9. Contact

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Department	Impact Assessment of CARBON EMISSIONS REDUCTION TARGET 2008-2011

Stage	Partial 04/05/07	Related Publications: Illustrative Mix of Measures

Available to view or download at:
www.http://www.defra.gov.uk/environment/energy/eec/index.htm

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What is the problem under consideration? Why is government intervention necessary?

Reduction of carbon dioxide emissions to reduce our impact on climate change and meet national, EU and international targets. For the household sector to deliver its share of necessary activity to improve energy efficiency and take up renewable sources of energy, we need to ensure that homes reduce their carbon dioxide emissions and consumers are made more aware of how their decisions and behaviour can affect carbon dioxide emissions.

What are the policy objectives and the intended effects?

The purpose of the CERT obligation is to help electricity and gas consumers in the household sector to reduce the carbon impact (footprint) of their home by using energy more efficiently, reducing consumption and using energy from renewable/microgeneration sources. In doing so they will reduce their fuel costs (and/or enjoy greater comfort). Through achieving carbon dioxide savings, the primary aim of the CERT is to make a significant contribution to the UK's legally binding target under the Kyoto protocol to cut greenhouse gas emissions by 12.5% below 1990 levels by 2008–2012 and its domestic goal to cut emissions of carbon dioxide by 20% below 1990 levels by 2010. It is expected that it will also contribute to the alleviation of fuel

What policy options have been considered? Please justify any preferred option.

1. A CERT obligation that would double the level of activity of the Energy Efficiency Commitment (EEC) 2005-08. This is the preferred option: an achievable target that would meet the Government's objectives by delivering the maximum possible level of carbon dioxide savings and maintaining equity for consumers.
2. A CERT obligation that would increase by 50% the level of activity of EEC 2005-08.
3. An obligation on energy suppliers based on a tradable target set in terms of reducing absolute energy demand or carbon dioxide emissions from the household sector.
4. A CERT obligation based on a formal tradable white certificate scheme.
5. Not imposing a CERT obligation.

When will the policy be reviewed to establish the actual costs and benefits and the achievement of the desired effects? Autumn 2011

Ministerial Sign-off For consultation stage Impact Assessments:

I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed by the responsible Minister:

Date: 4 May 2007

Ministerial Sign-off For final proposal/implementation stage Assessments:

I have read the Impact Assessment and I am satisfied that (a) it represents a reasonable view of the expected costs, benefits and impact of the policy, and (b) that the benefits justify the costs.

Signed by the responsible Minister:

Date: 19 November 2007

SUMMARY: ANALYSIS & EVIDENCE

Policy Option *Description*

ANNUAL COSTS

One off (Transition) £ 4.3bn Yrs 3

Average Annual Cost (excluding one-off)

£ 5m

Description and scale of **key monetised costs** by 'main affected groups'

- Cost to energy suppliers to promote carbon reduction measures (usually by subsidising them), which may be passed on to customers (£2.8bn)
- Cost to householders to pay for the balance of installing carbon reduction measures (£1.3bn)
- Cost to Local Authorities and Social Landlords contributing to the cost of measures installed in the social sector (£0.2bn)

Total Cost (PV) £ 4.0bn

Other **key non-monetised costs** by 'main affected groups'

'Hassle factor' – time of householders to get measures installed

ANNUAL BENEFITS

One off £ 0 Yrs

Average Annual Benefit (excluding one-off)

£ 821m

Description and scale of **key monetised benefits** by 'main affected groups'

- Energy cost savings and improved comfort for householders (Annual benefits: £695m, £660m excl. VAT on energy; PV: £12.0bn, £11.4bn excl. VAT on energy)
- Benefits to society of avoided damage from climate change due to reduced CO_2 emissions (shadow price of carbon (SPC)) of £2.8-3.1bn (£2.9bn).

Total Benefit (PV) £ 14.3bn

Other **key non-monetised benefits** by 'main affected groups'

- Improvement in energy security due to reduced energy demand
- Supporting innovation via incentives
- Helping to address fuel poverty
- Improvement in air quality

Key Assumption/Sensitivities/Risks

Cost of measures; Future energy prices; Mix of measures, i.e. numbers of installations for each measure (including considerations of constraints such as remaining potential, industry capacity, and demand); Savings per measure; social cost of carbon

Price Base Year 2007	Time Period Years 08-51	**Net Benefit Range** (NPV) £ 8.7-11.8bn	**NET BENEFIT** (NPV Best estimate) £ 10.3bn

What is the geographic coverage of the policy/option?	Great Britain
On what date will the policy be implemented?	1 April 2008
Which organisation(s) will enforce the policy?	Ofgem
What is the total annual cost of enforcement for these organisations?	£1.4m
Does enforcement comply with Hampton principles?	Yes
Will implementation go beyond minimum EU requirements?	No
What is the value of the proposed offsetting measure per year?	There is none

What is the value of the changes in greenhouse gas emissions?			£2.9bn	
Will the proposal have a significant impact on competition?			No	
Annual cost (£-£) per organisation (excluding one-off)	Micro 0	Small 0	Medium 0	Large 0.23m
Are any of these organisation exempt	N/A	N/A	N/A	N/A

Impact on Admin Burdens Baseline (2005 Prices)

Increase of £ 0.17m Decrease of £ - **Net Impact** **£** (Increase - Decrease) 0.33m

Key: **Annual Cost: Constant Prices** **(Net) Present Value**

Evidence Base
for Summary Sheets

Introduction

1. The Electricity Act 1989 and the Gas Act 1986, as amended by the Utilities Act 2000 and the Climate Change and Sustainable Energy Act 2006, contain powers for the Secretary of State, by Order, to impose an obligation on electricity and gas suppliers to achieve carbon dioxide emissions reduction targets.

2. This Impact Assessment (IA) considers the impact of a draft Order setting the framework for a carbon dioxide emissions reduction target to be imposed by the Secretary of State for the period 1 April 2008 to 31 March 2011. The draft Order would set a total obligation of 154 million tonnes of carbon dioxide ($MtC0_2$) lifetime savings (which is equivalent to 4.2 $MtCO_2$ annual net savings). Suppliers would meet their targets by encouraging and assisting domestic consumers to take up carbon reduction measures.

3. The obligation is known as the Carbon Emissions Reduction Target (CERT) and will apply in England, Scotland and Wales. The draft Order includes a requirement on suppliers to achieve at least 40% of their carbon dioxide savings from a priority group of low-income and elderly consumers.

4. The CERT would build on the success of the Energy Efficiency Commitment (EEC) as the Government's principal policy mechanism for cost-effective delivery of energy saving measures to households. The first phase of the EEC (2002-05) stimulated about £600m investment in energy efficiency and delivered net benefits to householders in excess of £3 billion. It is expected to save 1.1 $MtCO_2$ annually by 2010, with overall cost-effectiveness of about £82 per tonne of carbon dioxide saved (i.e. net benefits) and costs to suppliers of around £3.20 per customer per fuel per year. Around 10 million households have benefited from EEC 2002-05. EEC 2005-08 requires broadly double the level of activity of EEC 2002-05 and is expected to deliver 1.8 $MtCO_2$ annually by 2010.

5. The Climate Change Programme Review in 2006 has shown that EEC is one of the most cost-effective policies to reduce carbon dioxide emissions, with large net benefits. It was therefore decided to maximise carbon emission reductions via this policy mechanism.

6. The 2006 Act allowed the Government to extend the scope of the EEC to include microgeneration and behavioural measures, as well as energy efficiency. This will provide suppliers with more flexibility in meeting their targets and will enable a more holistic approach to carbon abatement in the household sector.

7. This document, together with the illustrative mix of measures in the Appendix, demonstrates that CERT is very cost-effective. Further cost-effective opportunities

continue to be available after CERT and on this basis the Energy Review 2006 and Energy White Paper 2007 committed to a supplier obligation at least to 2020.

Barriers to household energy efficiency – rationale for intervention

8. It has long been observed that levels of energy efficiency in the household sector are not optimal, either from a personal or societal standpoint. Simple measures which would cost-effectively reduce consumers' energy bills remain undone. When climate change and the broader benefits of reduced energy usage (other environmental benefits, security of supply, fuel poverty) are taken into account, the gap between the ideal and what is achieved in practice is even greater. It is considered that this is due in part to a number of market failures and other barriers which prevent or impede consumers from taking up energy saving opportunities.

9. These barriers must be overcome if we are to deliver energy savings from the household sector, and particularly if we wish to see a situation whereby energy saving measures are in demand from consumers. To the extent that these barriers can be overcome through policy intervention there is an important role for Government to intervene to correct what markets cannot deliver on their own.

The main barriers to household energy saving can be characterised in several distinct categories:

- ***Basic financial barriers:*** These include the potentially higher (upfront) costs of energy efficient products and the interest rates available to households.
- ***Hidden costs:*** These include "transaction costs" associated with finding reputable providers, time costs of disruption, and the costs of differences in quality of product or service—all of which may reduce the net benefit derived from efficiency measures.
- ***Lack of information:*** If households do not know their level of energy expenditure, how energy use can be reduced, by how much, or at what cost, they are unlikely to consider investment in energy efficiency.
- ***Risks and uncertainty:*** Uncertainty about future energy prices may deter households from investing, since they cannot be assured of future savings; households also may not be certain whether their tenure at a property will be sufficiently long for future savings to repay an initial outlay. In addition, households may be wary of the risk associated with new (or unfamiliar) products or services, and they may not trust energy suppliers or others who are promoting energy saving measures.
- ***Poorly aligned incentives:*** The most commonly cited barrier of this kind is the "landlord-tenant split", whereby landlords under-invest in energy-efficiency because tenants pay energy bills, or tenants do not economise on energy because the landlord pays the energy bill. Similar misalignments occur in the building industry and among property developers, often due in part to asymmetries of

information. Failure to incorporate environmental or other externalities (such as energy security) into energy markets is also included here.

- ***Psychological / sociological barriers:*** This category refers to a range of less tangible barriers that may explain consumer behaviour that does not conform to perfect "economic rationality". These may include inertia in decision-making (which may be due to loss-aversion and concerns about regret), the use of rules-of-thumb rather than more complicated full optimisation, and preferences that depend on the behaviour of others.
- ***Regulatory barriers:*** There are aspects of the energy market and its regulatory framework that could make it more difficult for households to benefit from or consider energy efficiency. Examples include limits on the types of "contracts" offered to households by suppliers, assignment of responsibility for metering, and treatment of (high-efficiency and/or low-carbon) distributed generation.

(Source: NERA)

10. There are also other important practical factors that can potentially impede the delivery of improvements to household energy efficiency including a lack of appropriate market-ready technologies, lack of appropriate skills and supply-side constraints on the supply and installation of measures.

11. Household energy suppliers are well-placed to deliver carbon dioxide savings from their customers, and are able to tackle many of the barriers outlined above to do so. Suppliers are able to tackle financial barriers, with an ability to source measures in bulk thus securing them at lower cost than individual consumers, they can also subsidise measures as they currently do under EEC, or offer finance, potentially repaid via customer bills and linked to energy savings. By supporting delivery of measures they can reduce some hidden costs such as the finding of suitable measures and engaging trustworthy installers, although to some hidden costs are inevitable – disruption and changes to quality of service, for example. Suppliers are uniquely placed to provide information about a consumers' energy consumption, and are well placed to inform them about the potential measures on offer. Suppliers can mitigate some of the risks and uncertainty faced by consumers, around the value of energy savings and energy prices, and technical risks of measures installed, but there are others that they cannot, such as length of tenure or the option value of waiting for new or improved technologies. While suppliers are well placed to deliver energy savings from consumers, there remain barriers that they cannot tackle on their own, and successful delivery of savings from households will need to be supported by action by Government and others (as shown in the Energy White Paper 2007).

Evidence base

12. EEC has been in operation since 2002 and was preceded by the Energy Efficiency Standards of Performance. A large amount of evidence has been accumulated over the years, partly based on experience and evaluation, and partly based on a programme of

commissioned research carried out to address specific issues. In addition there are several data sources that are collecting relevant information on an ongoing basis and are published regularly, such as the English House Condition Survey[1] and the Domestic Energy Fact File[2]. Much of this evidence is available from Defra's websites on EEC[3] and Research and analysis[4]. Where appropriate the relevant references are given in the Illustrative Mix document (see Appendix) and in other relevant documents available on Defra's website. Ofgem publishes quarterly updates and annual reports on EEC.[5] More generally, evidence on energy efficiency policies was presented as part of the Energy White Paper 2002, the Energy Efficiency Action Plan 2004, the HMT/Defra Energy Efficiency Innovation Review 2005, the UK Climate Change Programme Review 2006 , the Energy Review 2006 and the Energy White Paper 2007.

Options considered

13. In order to meet the Government's policy objective of saving energy and reducing carbon dioxide emissions from households, five options were considered.

Option 1: a CERT obligation that would broadly double the level of activity of the Energy Efficiency Commitment (EEC) 2005-08. As stated in summary, this is the preferred option. The proposed target of 154 $MtCO_2$ lifetime savings (which is equivalent to 4.2 $MtCO_2$ annual net savings) would deliver the maximum possible level of carbon dioxide savings whilst maintaining equity for consumers. On the basis of the detailed analysis set out below, the Government considers this to be a challenging but achievable target.

Option 2: a CERT obligation that would increase by around 50% the level of activity of EEC 2005-08. The 2006 Climate Change Programme indicated that CERT (then referred to as the third phase of the Energy Efficiency Commitment), could deliver about 0.9 to 1.2 MtC (3.3-4.4 $MtCO_2$) by 2010. This represented an increase of 50-100% of the level of activity under EEC 2002-05. The range was indicated near the outset of extensive informal and formal consultations that have taken place on the development of CERT (see paragraphs 47-50). Throughout this process the Government sought to develop a challenging target, taking account for example of the flexibility offered by the Climate Change and Sustainable Energy Act to extend the range of measures available to suppliers.

While the costs of Option 2 would be lower than option 1, it would also result in lower carbon dioxide savings and lower net benefits, resulting in a reduced contribution in the household sector to the Government's climate change objectives.

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[1] http://projects.bre.co.uk/energyuse/
[2] www.defra.gov.uk/environment/energy/research/domestic/index.htm
[3] www.defra.gov.uk/environment/energy/eec/index.htm
[4] www.defra.gov.uk/environment/energy/research/
[5] www.ofgem.gov.uk

Option 3: an obligation on energy suppliers based on a tradable target set in terms of reducing absolute energy demand or carbon dioxide emissions from the household sector. It became clear at an early stage that this would require primary legislation. Accordingly, this possibility is being evaluated as one option for the household obligation on energy suppliers from 2011 to at least 2020 that the Government announced in the 2006 Energy Review**.**

Option 4: a CERT obligation based on a formal tradable white certificate scheme. A study undertaken for Government by NERA Economic Consulting on options for increased trading in the Energy Efficiency Commitment concluded that trading already forms an effective part of the EEC mechanism and that a move to a formal white certificate scheme would not provide any additional benefits. The study indicated that the options considered would also require primary legislation. Such mechanisms form part of the consideration for the supplier obligation post-2011.

Option 5: not imposing a CERT obligation. This would not contribute to mitigating the risks of climate change and would mean that the Government's objectives for the reduction of carbon dioxide emissions could not be met. It would be a retrograde step not to build on the success of the current EEC. It would also be damaging to industries that have expanded to meet its demands and planned on the basis of an increased obligation announced by Government in the 2006 Climate Change Programme.

In the absence of a CERT obligation, only a small proportion of the 154 $MtCO_2$ lifetime savings would be achieved by consumers taking up measures in the absence of suppliers' promotional activity. Some savings would be achieved as a result of consumers action in the absence of CERT, as indicated under the assumption in paragraph 15 relating to deadweight**.**

Benefits and costs

14. The costs and benefits of CERT options (particularly the level of the target) are established using an Illustrative Mix of Measures representing a balanced selection of measures. The data and assumptions underlying the Illustrative Mix are informed by information provided by energy suppliers, by representatives of the industries concerned, and by experts, including the Energy Saving Trust (EST) and the Building Research Establishment (BRE).

15. The analysis behind the illustrative mix takes account of a number of issues including:

- The likely **number of each possible measure** installed over the period 2008–2011. This has been assessed to take account of potential constraints such as the current state of the housing stock, of other physical and market constraints, of typical replacement cycles for boilers and appliances, and of consumer demand;
- Estimates of the **unit cost of each measure** are based upon the set of EEC 2005-2008 illustrative mix figures, allowing for 3 years' inflation to convert to 2007 prices. While real costs per measure have declined significantly over the successive Energy Efficiency Standards of Performance (EESoP) and EEC 2002-2005 and 2005-08 schemes, it is recognised that from 2008 the costs for some measures, such as insulation, are likely to increase;
- The **supplier contribution** is the share of the direct cost of the measures that the supplier is likely to have to meet, in order to induce the householder to take up the offered CERT measure. This is based on the cost to the supplier and the final price that the consumer is prepared to pay. The difference is the supplier contribution, or inducement cost. The level of the subsidy or inducement cost will depend on the householder's willingness and ability to pay. For this reason, households on income or disability benefits, or elderly households (the Priority Group) are expected to require higher inducement than other households.
- Under CERT, the approach of Ofgem is to accredit suppliers for activity that it deems would not have occurred without the suppliers' promotional activity, to ensure that there is real additional benefit from the activity. Where possible, Ofgem has implemented proposals to take account of this in the approval and monitoring processes. This is reasonably straightforward for measures in social housing, and for appliances, but it has been necessary to assume that when suppliers offer some measures under the CERT, they will unavoidably pick up and meet the cost of assisting consumers who would have taken the measure in any event (**deadweight**), as well as stimulating additional take-up. Thus the lifetime carbon dioxide savings attributed to the CERT count the savings benefits from all installations, including the business as usual deadweight. This avoids the otherwise intractable problem of allocating deadweight to supplier's activity when determining the carbon dioxide savings they have achieved. Note that the majority of deadweight activity takes place in the able to pay sector.

- Indicative estimates of **suppliers' costs of developing and administering the CERT** programmes additional to the inducement cost, are on average around 14.5% of total programme costs. Implementation costs are higher for lower cost measures and lower for higher cost measures;
- **Energy improvement** is defined as the benefit to the household from an energy efficiency measure, either from lower bills, or from increased comfort (for example, in terms of increased warmth);
- The **annual carbon dioxide saving** resulting from each installation has been calculated using the annual energy saving, minus the comfort taken, and the carbon intensity of the fuel saved (e.g. for condensing boilers this would be the carbon intensity of gas). The carbon intensities for each fuel are consistent with Defra's Environmental Reporting – Guidelines for Company Reporting on Greenhouse Gas Emissions.
- The **assumed lifetimes** for the measures in the Illustrative Mix are generally the same as those used in setting the EEC 2005-08 targets and were estimated following discussions with experts including the BRE and EST.
- The annual carbon dioxide savings are multiplied by the assumed lifetimes to give **lifetime carbon dioxide savings** for each measure, i.e. the scores, which is the basis for counting towards the CERT target. We consulted on the scores for established measures which are now set.[6]

16. The analysis has taken account of concerns that the industry may be unable to meet suppliers' demands for extra activity. Views from the energy suppliers, the insulation manufacturers, and the insulation installers were considered, in addition to independent reports on the insulation industry.[7] Overall this risk is considered to be relatively low/moderate. (see Appendix, section 2.3)

17. The analysis has also considered the possibility that the energy efficiency measures included in the illustrative mix may not perform as expected and do not deliver the proposed carbon dioxide impact. There is a risk that some of the measures do not deliver the full energy saving potential as determined, because of different behaviour/usage than assumed or because of physical underperformance. Continuing monitoring studies are eliminating or reducing this risk. Furthermore, allowance for potential underperformance of insulation measures is implicitly included in a "reduction factor" of 50%, as studies suggest that actual savings in the field are less than theoretical savings.[8] This reduction factor includes a factor of 15% for comfort taking. So therefore the risk on carbon dioxide savings due to underperformance is considered low. Given the uncertainty about future energy prices, and the potential for some price reductions in the near future, there is some risk that the benefits may be slightly overstated (see below for sensitivity).

18. The carbon dioxide savings of 4.2MtCO_2/yr at the end of the programme are estimated net of comfort taking and of business as usual activity. The annual energy savings are the basis on which the energy cost benefits are calculated, using 2007 energy

[6] www.defra.gov.uk/corporate/consult/eec3-2007/index.htm
[7] www.defra.gov.uk/environment/energy/eec/pdf/supply-chain-review.pdf
[8] www.defra.gov.uk/environment/energy/research/pdf/insulationmeasures-review.pdf

prices for each fuel. On the other hand, the obligation target score is set in terms of lifetime carbon dioxide savings (gross of deadweight). The lifetime of the carbon dioxide reduction measures must be taken into account when determining the lifetime carbon dioxide savings, and are typically in the range of 10-40 years. The appraisal period is therefore 2008-51.

19. CERT as proposed would benefit the **environment** by reducing carbon dioxide emissions by about 4.2 $MtCO_2$ per year at the end of the programme and 132 $MtCO_2$ net savings over the lifetime of the measures, helping to tackle climate change and improve local air quality (see Appendix, Table 9). The annual carbon dioxide savings equate to about 2.4% of current emissions[9]. In addition reduced energy demand will moderate wider environmental impacts of energy extraction, production and supply. In contributing to the Government's climate change abatement programme, all consumers will share the benefits such as cleaner air and the mitigation of carbon dioxide emissions from reduced energy production. CERT is expected to be highly cost-effective with around £48 benefits per tonne of carbon dioxide saved (excluding ancillary benefits). (See Appendix, Table 9.)

20. Considering the shadow price of a tonne of carbon dioxide is £25.50 in 2007, rising by 2% per year, the carbon dioxide savings equate to additional benefits of £2.8-3.1 bn or about £2.9 bn (net present value).

21. CERT as proposed would provide **social benefits** through reducing fuel bills and improving comfort, thus also contributing to the alleviation of fuel poverty and the risk of ill health caused by cold homes, particularly for children and the elderly. CERT activity reduces carbon dioxide emissions from the housing stock and improves the energy efficiency in most cases. CERT would also provide particular help to those on low-incomes, or disability benefits, or elderly householders by requiring 40% of energy savings to be focussed on a priority group of those in receipt of benefits and tax credits or pension credit, and households over 70, which, together, make up about 40% of all households.

22. It is estimated that the cost to suppliers is around £105 per household for the 3 years of the CERT programme (see Appendix, Table 9). If passed on to customers in full, this is equivalent to about 4.5% of annual energy bills. This is roughly an additional 2.5% or £20 per household compared to today's energy bills which include costs for the current EEC.

23. These costs are balanced by average annual benefits, in terms of lower energy bills or increased comfort, of about £29 per household for the lifetime of the measures, continuing for many years (often several decades) beyond the CERT period (see Appendix, Table 9). On average, the net impact on energy bills is therefore low for the 3 years of the programme, and afterwards energy bills would reduce by around 3.5-4% on average (unless a similar obligation continues).

[9] Emissions for the residential sector in 2005 were estimated at 172.3 $MtCO_2$ per year see BERR updated Energy & Carbon Projections, May 2007, http://www.berr.gov.uk/files/file39580.pdf

24. The EEC/CERT does not dictate what measures suppliers must take in order to meet their obligations. The suppliers are operating in a competitive market and so will want to retain customers by keeping prices down.

25. CERT as proposed would provide **economic benefits** in promoting innovation by creating market opportunities for new or more efficient technologies and by providing certain incentives for demonstration and market transformation. CERT will also contribute to improving security of energy supply by reducing demand in the domestic sector.

26. Costs for the current (and past) EEC were based on discussions with energy suppliers, the relevant industries and the Energy Saving Trust taking into account evidence from the energy suppliers about the costs of past programmes and the costs of the Government's Warm Front programme. The costs for CERT have been similarly estimated on the basis of discussions with suppliers of carbon reduction products and services, plus information about the costs of the EEC 2005-08. (See Appendix, Section 2.4).

27. The costs given in this impact assessment are the total net resource costs, not just the subsidies expected to be given by suppliers through the CERT. In other words, some beneficiaries of the CERT programme are given a 100 per cent subsidy, whilst others part fund the product or service provided. All the monies spent by the suppliers, homeowners and landlords are counted, and then debited by the estimated business as usual investment in these energy savings measures during the CERT period. The corresponding savings are discounted at the 3.5 per cent Treasury rate.

28. The estimated ongoing annual energy savings to consumers, after subtracting comfort taking, would reach a total of around £759m in gross terms by the end of the CERT period. This represents approximately £635m net of business as usual activity. It is estimated that the measures installed under the CERT would provide an average annual ongoing gross financial benefit for consumers, in lower energy bills, of about £29 per household. These benefits will continue beyond the CERT period, for the lifetime of the measures.

29. Overall savings (net of business as usual improvements) to householders are estimated to amount to a net present value of around £11.9bn over the lifetime of the measures, or £11.4bn if VAT is not included. Comfort taking is estimated to account for around 8.5% averaged over all measures. As the benefits of CERT are due to energy savings (or comfort taking with equivalent value), the magnitude of the benefits is directly proportional to the energy prices. Even if energy prices were halved, and even when excluding the shadow cost of carbon, the benefits would still be around 50% larger than the costs.

30. The net resource cost over the CERT period for all parties (i.e. total cost of measures net of business as usual deadweight, plus implementation costs) is

approximately £3.8bn. If deadweight is included, this rises to £4.3bn. Implementation and administration costs represent around 14.5% of total costs. The suppliers' share of total costs is £2.8bn. (See Appendix, Section 2.4).

31. The above analysis of costs and benefits relates to the Government's Illustrative Mix of Measures. Under the EEC 2002-05 and the current EEC, the measures adopted by suppliers have been broadly in line with the Illustrative Mixes for the respective programmes.[10] However, if suppliers were to adopt a different mix of measures, the outcomes in terms of costs and benefits could be different, because of the differing cost/savings ratios of measures, and disparate prices of electricity and fossil fuels.

32. The proposed target is based on comprehensive analysis. If, in the event of unforeseen circumstances that significantly affected the Government's assumptions, it were necessary to reconsider the level of carbon reduction obligation, any amendment would be effected by a further statutory instrument, following consultation.

Equity and fairness

33. The Government has considered how it can best achieve its climate change abatement objectives through the CERT whilst ensuring equity and fairness for consumers. Under the CERT, obligated suppliers will seek to meet their targets as cost-effectively as possible. These costs will potentially be passed on in full or in part to consumers of electricity and gas through their bills. For those consumers receiving energy efficiency measures under CERT the savings are likely to outweigh any increase in their bills. Some consumers may receive measures at no cost, while others may receive subsidised measures. Ofgem's monitoring of CERT, to determine whether suppliers achieve their obligations, is on the basis of numbers of measures installed, rather households which receive measures. Some households may benefit from more than one measure.

34. Those on low incomes are most likely to be affected by any increase in energy bills since they spend a higher proportion of their income on electricity and gas. In recognition of this the draft Order would require suppliers to direct at least 40% of their carbon dioxide savings to a Priority Group of low-income or elderly consumers, who make up about 40% of all households. This will ensure that low income and vulnerable consumers receive a fair share of the benefits of the CERT.

35. The CERT Priority Group is defined as householders in receipt the following benefits or tax credits:

- council tax benefit
- housing benefit
- income support

[10] See e.g. evaluations of EEC 2002-05 (www.defra.gov.uk/environment/energy/eec/pdf/eec-evaluation.pdf and www.defra.gov.uk/environment/energy/eec/pdf/eec-assessment.pdf), and Ofgem's quarterly and annual reports on EEC.

- income based jobseekers allowance
- attendance allowance
- disability living allowance
- disablement pension which includes a constant attendance allowance
- war disablement pension which includes a mobility supplement or a constant attendance allowance
- child tax credit (where the consumer's relevant income is £15,592 or less)
- working tax credit (where the consumer's relevant income is £15,592 or less)
- state pension credit

and all householders with one or more members aged 70 or over.

36. The draft Order includes a flexibility option, under which an energy supplier would be able to notify Ofgem that it wished to achieve a proportion of its priority group obligation by focussing specified measures on low-income consumers who are more likely to be in fuel poverty. The focus will be on consumers in the private sector who are receipt of benefits and tax/pension credits specified in the Order. The measures specified in the Order are solid wall insulation, to homes both on and off the gas grid, and ground source heat pumps to homes off the gas grid. A supplier would be able to meet 12.5% of its priority group obligation through this option.

37. While the measures installed under CERT would provide an average annual ongoing benefit for consumers of about £29 per household (for the lifetime of the measures), there is a proportion of consumers whose energy bills will increase as a result of CERT, but who may not receive corresponding energy saving measures under the scheme. These are most likely to be households living in private rented accommodation and some owner occupiers in older houses, which do not have the potential for cavity wall insulation, and/or who may have already carried out all cost-effective energy saving measures in their home. The flexibility option described above is intended to direct measures to low-income consumers in this group. Furthermore, while such consumers may not receive fabric measures under CERT, they may still benefit from retail goods promoted by suppliers, such as energy efficient appliances and light bulbs.

38. Manufacturers and suppliers of carbon reducing products and services such as cavity wall insulation, loft insulation, solid wall insulation, heating systems and microgeneration technologies will benefit from a growth in the size of these markets. It is not possible to know what changes in the pattern of production and consumption will result in other areas of the economy and hence whether there are losses as a result of these gains.

Competition issues

39. Competition issues arise in two different markets – the market for energy supply and the market for energy/carbon saving measures. CERT does not create any barriers to entry into the market for the supply of electricity or gas.

However, since it is an obligation on suppliers, it does raise the entry costs, although these costs may be passed through to consumers.

40. Suppliers' individual CERT obligations are based on their customer numbers. So as not to deter new entry by small firms and to reflect the relatively higher costs incurred by small companies, the obligations are not imposed on firms supplying less than 50,000 customers.

41. Suppliers are able to pass on the costs of their obligations under the CERT. A supplier that is inefficient is likely to lose customers, who have the freedom to switch to another supplier.

42. Suppliers have an incentive to keep the costs of their obligations under CERT as low as possible in order to minimise the amount of any pass through. This reflects the competitive supplier market and the drive to retain or acquire customers. Suppliers therefore have an incentive to be competitive in the supply of energy/carbon saving products and services. Barriers to entry into the market for most efficient energy/carbon saving products and services are relatively low.

43. Whilst some suppliers may choose to undertake a large proportion of their obligations through in-house contractors, there is no reason to suppose this will reduce competition in the rest of the energy supply market.

44. It is possible that short run bottlenecks could develop in the supply of certain energy efficient products such as loft insulation or cavity wall insulation, given a projected rapid expansion in the market for these products. Any resulting price increases are likely to be short lived, given that new market entry is possible. The indication given in the 2006 Energy Review that there will be a supplier obligation from 2011 to at least 2020 could help induce new market entry.

Small firms' impact

45. The proposals will not impose costs on small businesses. The draft Order does not apply to new and small energy suppliers with fewer than 50,000 customers. This means that new entrants would not have to set up CERT programmes while at an early stage. The draft Order contains other provisions that avoid the risk of creating barriers to new entrant companies: where a supplier prefers not to set up its own CERT programmes, then it may transfer all or part of its target to another supplier, purchase accredited performance from another supplier or contract out the operation of its programme.

Race equality, gender equality and rural impact

46. Under CERT, there will be opportunities for all consumers to benefit from measures, regardless of race or gender. There will be opportunities for consumers in both rural and urban areas to benefit.

Consultation

47. In developing its proposals for CERT, the Government has engaged with a wide range of stakeholders, including electricity and gas suppliers, representatives of energy efficiency industries, local authorities and other representative bodies and organisations with an interest in energy efficiency, carbon reductions, fuel poverty and the environment. The Government held two consultation events in March 2006 and October 2006, with the support of the Energy Efficiency Partnership for Homes. In July 2006 the Government issued an Initial Consultation on EEC3 (now known as CERT) in order to solicit early views to inform the statutory consultation. A summary of responses to the Initial Consultation was published on 12 January 2007.

48. Defra published a first draft Illustrative Mix of Measures in September 2006 and consulted on the energy and carbon dioxide savings for well-established measures between 12 January and 12 February 2007. In March 2007 Defra published a summary of responses and, in order to provide certainty and facilitate carry over of activity from EEC2 to CERT the "Final energy and carbon dioxide savings for the EEC 2008-11 Illustrative Mix"[11] (the final scores for standard CERT measures).

49. The statutory consultation on the "Carbon Emissions Reduction Target April 2008 to March 2011"[12] was published in May 2007. A brief summary of the responses is at Annex A.

50. The proposals reflected in the draft Order take account of the comments received throughout the whole of the consultation process, particularly the statutory consultation in May 2007. They also take account of the latest information on the costs of carbon saving measures and other parameters that are likely to determine suppliers' costs in meeting their CERT obligations, including information about delivery of the current EEC.

Implementation and enforcement

51. The Regulator, Ofgem, will be responsible for the operation of the CERT, including monitoring and enforcement. The draft Order provides for this. The procedures that suppliers will follow in order to achieve their carbon dioxide emissions reduction obligations will be set out in Ofgem's Supplier Guidance. Ofgem consulted on its

[11] http://www.defra.gov.uk/environment/climatechange/uk/household/eec/pdf/illustrativemix-final2007.pdf
[12] http://www.defra.gov.uk/corporate/consult/cert2008-11/index.htm

"Carbon Emissions Reduction Target (CERT) Supplier Guidance"[13] in August 2007 and will publish the final guidance as soon as the Order comes into force.

Monitoring and evaluation

52. Ofgem will report annually to the Secretary of State on progress on CERT and the Government will review the three-year programme in autumn 2011.

Summary

53. The draft Order proposes that the CERT for 2008-2011 will have an overall obligation of 154 $MtCO_2$ lifetime savings which is equivalent to net savings of about 4.2 $MtCO_2$ per annum.

54. CERT as proposed will make a significant contribution to the Government's UK Climate Change Programme. It will provide financial and social benefits for consumers, particularly those on low incomes, and work alongside other relevant Government policies to deliver reductions in carbon dioxide emissions.

55. The proposed level of obligation should stimulate a significant increase in energy/carbon dioxide savings without placing onerous costs on the energy supply companies – or the consumer. Building on the success of the EEC, CERT will continue to provide energy suppliers with the freedom and incentive to develop the most innovative and cost-effective programmes of energy/carbon saving measures.

56. In conclusion, the Government considers that option 1 in paragraph 13 above is likely to contribute effectively to the reduction of carbon dioxide emissions in the household sector, at reasonable cost to suppliers and consumers with substantial benefits to the UK, and taking account of the practical capacity of the energy saving and microgeneration industries in the relevant period.

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http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=176&refer=Sustainability/Environmnt/EnergyEff

Complementary Impact Tests

Type of test undertaken	***Stage reached***	***Impact?***	***Results annexed?***
Competition Assessment		No	*See paras 38-43 above*
Small Firms Impact Test		No	*See para. 38 above*
Legal Aid			
Sustainable Development		*Yes*	*Throughout document*
Carbon Assessment		*Yes*	*See paras 15 and 18-20 above*
Other Environment		*Yes*	*See paras 19-20 above*
Health Impact Assessment			
Race Equality		No	*See para.45 above*
Disability Equality		Yes	*See para.21 above*
Gender Equality		No	*See para.45 Above*
Human Rights			
Rural Proofing		*No*	*See para.45 above*

ANNEX A

CARBON EMISSIONS REDUCTION TARGET APRIL 2008 TO MARCH 2011 (CERT)
BRIEF SUMMARY OF CONSULTATION RESPONSES

The statutory consultation on CERT ran from 23 May 2007 to 15 August 2007. A wide range of bodies were consulted, including electricity and gas suppliers, manufacturers and installers of energy efficient products, trade associations, other representative bodies, local authorities and organisations with an interest in carbon saving, fuel poverty and the environment. There were 72 responses. A full summary of responses is being published on the Defra website.

Scale of CERT

Of those who commented on the proposed scale of CERT about half welcomed the proposed doubling of activity over EEC2, while a few pushed for it to be even higher in ambition. Some (including energy suppliers, but also some social groups) suggested that the proposed scale was very challenging and could have significant impacts on costs to customers – there were concerns that Defra's analysis had underestimated the costs. A number of respondents suggested that the Government should take action to increase customer demand (eg fiscal incentives, marketing campaigns), in order to make the challenging targets more feasible.

Priority Group Obligation

There were a range of views from respondents who commented on the scale of the Priority Group (PG) obligation Energy suppliers, climate change groups and those responsible for practical delivery of measures, considered that the proposed 40% priority group obligation was not achievable. They believed that Defra's analysis was optimistic in a number of respects and referred to detailed joint analysis by the Energy Retail Association and National Insulation Association, which suggested that an obligation of 40% was not possible. A number pointed out the practical negative impacts of a large PG obligation, for example on effective delivery of measures and relations with customers in the able to pay sector.

While accepting that it was a challenge for the Government to find an acceptable balance between environmental and social objectives, the fuel poverty lobby appeared to be unconvinced by Defra's analysis of the maximum possible level for the PG obligation. Some consultees suggested that the PG obligation should 50%. 45% was also suggested.

Priority Group Flexibility Option

This was welcomed by a significant number of respondents, although many suggested that it was too constrained in its proposed format to be fully effective. There were a number of suggestions for adapting or widening the proposed criteria for the Flexibility Option. A number of respondents suggested that the ring-fence should be increased to 10%.

Innovation

Consultees welcomed the proposed CERT routes for innovation. The majority of those who commented called for the ring-fence around innovation to be increased, generally to 10%.

A number of respondents sought a separate innovation route or ring-fence for microgeneration. They suggested that the proposed support for innovation would not be enough to drive or encourage microgeneration measures or that microgeneration might be pushed out of the ring-fence by other forms of innovation.

A few respondents proposed that Solid Wall Insulation should be specifically supported under the market transformation innovation route, as this would need to develop as a significant measure post 2011.

APPENDIX

Appendix

Illustrative Mix of Measures for CERT 2008-11

Tables

Introduction

This note describes the draft Illustrative Mix of measures for the Carbon Emission Reduction Target (CERT).

This work should be seen as a development from considerations for EEC 2005-08 (and previous schemes) and many of the principles and assumptions are similar to those of EEC 2005-08 (EEC2) (see for example EEC2 consultation document and Background note to EEC2 Illustrative Mix[14]). It follows on from the first CERT/EEC3 consultation[15], the first draft Illustrative Mix[16] and the consultation on the savings/scores for the standard measures[17], and takes account of stakeholders' and experts' input.

The Government announced in Budget 2006 that its ambition for CERT was an increase of 50-100%; and that five of the major suppliers had agreed to an additional combined 250,000 insulation measures during EEC2 (and subsequently one supplier confirmed a further 50,000 measures), which Government would allow to count towards their CERT targets.

The Illustrative Mix is a tool which allows Government to develop a CERT framework to be ambitious but, at the same time, to be reasonable and achievable. It is also used to gauge the likely impact on a number of key variables, particularly overall costs and benefits, implications for the energy efficiency industry (and especially the Cavity Wall Insulation (CWI) sector), and for the share of the Priority Group (PG).

The overall lifetime carbon dioxide savings are 154 $MtCO_2$ delivering annual net savings of 4.2 $MtCO_2$ at the end of the programme – more than doubling EEC 2005-08 which is estimated to save about 1.8 $MtCO_2$ per year.[18] The Priority Group share of the target is 40%. However, the priority group has been expanded to include all households with a member over the age of 70, as well as all those who previously qualified for EEC2. For the purposes of simplicity, for the remainder of this document, the priority group shall be referred to as the "PG", and that part of the priority group that is on benefits shall be referred to as the "BPG".

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[14] www.defra.gov.uk/environment/energy/eec/

[15] The Energy Efficiency Commitment April 2008 to March 2011: Initial consultation, (Defra, July 2006), www.defra.gov.uk/corporate/consult/eec3/consultation.pdf

[16] The first draft Illustrative Mix of measures for the Energy Efficiency Commitment 2008-11, (Defra, September 2006), www.defra.gov.uk/environment/energy/eec/pdf/illustrative-mix.pdf

[17] Energy, cost and carbon saving calculations for the draft EEC 2008-11 Illustrative Mix, (Defra, Jan. 2007), www.defra.gov.uk/corporate/consult/eec3-2007/index.htm

[18] The annual carbon dioxide savings for EEC2 were previously estimated to be about 2.2 $MtCO_2$ in 2010; however, recent evidence suggests that some measures have lower savings than previously thought, which reduces this estimate.

A general description of the model

Energy, fuel cost and carbon dioxide savings were calculated for a range of domestic carbon-saving measures. An estimate was made of the number of installations of each measure likely to be made during the course of CERT. This estimate is our approximation of the way in which suppliers might approach their CERT obligations. However, it must be emphasised that it is purely illustrative for analysis purposes and does not necessarily reflect the way in which suppliers might choose to proceed in practice, nor is it intended to suggest particular targets or levels of activity that can be derived from any particular measure. For each measure, the estimated number of installations was multiplied by the saving per unit to calculate the total energy, cost and carbon dioxide savings. These values were summed to estimate the total benefits.

Evaluation of savings

Annual energy savings from heating and insulation measures were estimated using BREDEM[19]. Savings for other measures were calculated by various methods, based on their likely effect on the energy consumption of a 'base case' dwelling (see also below under 0). Delivered energy savings were multiplied by fuel carbon dioxide intensity and fuel cost factors obtained from BERR, to derive annual carbon and fuel cost savings respectively. A lifetime for each measure was used to calculate lifetime carbon dioxide savings. The resulting values form the basis of the 'score' which Ofgem would attribute to each measure, to be credited toward the target for each of the energy supply companies under the CERT. The scores for standard, well-established measures have been subject to consultation and their final scores were published in March 2007[20].

Scores for new measures, such as microgeneration, were presented in the 2007 consultation. In consultation with BRE, Ofgem and other experts, Defra has now produced final carbon dioxide saving scores for these measures. Further details are given in the annex to this document.

Evaluation of number of installations

As an illustration of how a scenario for achieving a particular target might look, the number of measures to be installed under CERT was estimated. This was based on past experience under previous phases of EEC, the likely cost-effectiveness of each measure for the suppliers and the likely limit of capacity of the installation and manufacturing industry. Generally speaking, the most cost-effective measures are assumed to be close to the maximum number that could be installed during the CERT period. In addition, for each measure an assumption was made on the proportion of installations to be made in the priority group.

[19] BRE Domestic Energy Model http://products.ihs.com/cis/Doc.aspx?AuthCode=&DocNum=83783
[20] www.defra.gov.uk/environment/energy/eec/pdf/illustrativemix-final2007.pdf

Assumptions and inputs

General inputs

The following general inputs are used by the model (figures in brackets represent what was assumed for the Illustrative Mix):

- Number of households projected for 2011 (26.2 million)
- Number of customers and annual energy bills (48.1 million)
- Number of households in the priority group (10.5 million)
- A discount rate to be applied to financial benefits accruing in future years (standard Treasury Green Book[21] discount rate of 3.5%)

The number of households in Great Britain is projected to increase from 25.3 million in 2005 to 26.2m in 2011 (Source: Office of National Statistics); this is also the number of electricity customers. Ofgem estimates that there are about 21.1m gas customers today. If we project forward at the same rate as the number of households, the number of gas customers increases to 21.9m. The total number of energy customers is therefore projected to be 48.1m.

The number of households on benefits is estimated to be about 8.5-9.0 million households as explained in Note A. We use a central value of 8.8 million. For CERT, the priority group has been expanded to include all households with a member over the age of 70. This equates to around 1.7 million households. The overall priority group size has therefore been taken as 10.5 million

Note that this is different to the assumptions used for EEC1 and EEC2, when the priority group was limited to those on benefits / income support.

Energy, Fuel Cost & Carbon Dioxide Savings per Measure

The following inputs relating to savings are also required (and are shown in Tables 1-2 below):

- Energy, fuel costs and carbon dioxide savings for each measure (with each of the 7 heating types considered).
- The level of comfort taking expected in each case[22].
- For each measure, the proportion of installations in dwellings with each heating type.
- The expected number of years during which the measure will provide benefits (i.e. the 'lifetime' of the measure).

[21] "The Treasury Green Book, Appraisal and Evaluation in Central Government", HM Treasury http://www.hm-treasury.gov.uk/media/9/C/Green_Book_03.pdf

[22] When insulation is fitted in a home, the customer may take part of the benefits as increased comfort, rather than reduced fuel consumption. The fuel, cost and carbon dioxide savings in this case are lower than would be expected. This is termed "comfort taking".

The energy, cost and carbon dioxide savings shown in Tables 1-2 are those averaged over all heating types considered. Note that most savings refer to a three bedroomed semi-detached property, which is considered to be the stock average. The exceptions are the community heating measures, which are assumed to be installed in blocks of flats.

Table 1: Annual savings per measure for the average 3-bed semi-detached house (weighted average of all fuels, and taking account of any correction factors)

		Gross savings					Net savings			
Measure	**Comments on the size of property assumed**	**Energy MWh/yr**	**Fuel Cost £/yr**	**Carbon, kgC/yr**	**Carbon dioxide kgCO2/yr**	**Comfort factor**	**Energy MWh/yr**	**Fuel Cost £/yr**	**Carbon, kgC/yr**	**Carbon dioxide kgCO2/y**
Cavity wall insulation	3 bed semi	3,544	£91.60	203.54	746.31	15%	3,012	£77.86	173.01	634.36
Loft insulation (professional)	3 bed semi	1,752	£45.19	100.54	368.66	15%	1,489	£38.41	85.46	313.36
Loft insulation (DIY)	3 bed semi	1,503	£38.76	86.23	316.19	15%	1,277	£32.95	73.30	268.76
SWI external to U value of 0.35W/m2K	3 bed semi	12,356	£319.10	709.14	2,600.19	15%	10,502	£271.23	602.77	2,210.16
SWI internal to U value of 0.45W/m2K	3 bed semi	11,680	£301.71	670.51	2,458.54	15%	9,928	£256.45	569.93	2,089.76
Insulated wallpaper	3 bed semi	4,020	£112.12	230.60	845.52	15%	3,417	£95.30	196.01	718.69
Tank insulation - top-up	3 bed semi	941	£23.85	53.88	197.57	15%	800	£20.27	45.80	167.94
Draughtproofing	3 bed semi	743	£19.17	42.61	156.25	15%	631	£16.30	36.22	132.81
Glazing E to C rated	3 bed semi	458	£11.86	26.35	96.62	15%	389	£10.08	22.40	82.12
A/B rated boilers (exceptions)	3 bed semi	1,866	£43.58	97.21	356.45	0%	1,866	£43.58	97.21	356.45
Fuel Switching	3 bed semi	7,116	£502.19	1,107.52	4,060.92	0%	7,116	£502.19	1,107.52	4,060.92

		Gross savings					Net savings			
Measure	**Comments on the size of property assumed**	**Energy MWh/yr**	**Fuel Cost £/yr**	**Carbon, kgC/yr**	**Carbon dioxide kgCO2/yr**	**Comfort factor**	**Energy MWh/yr**	**Fuel Cost £/yr**	**Carbon, kgC/yr**	**Carbon dioxide kgCO2/y**
Heating controls - upgrade with boiler	3 bed semi	181	£4.30	9.57	35.09	0%	181	£4.30	9.57	35.09
Heating controls – extra	3 bed semi	1,457	£34.62	77.02	282.41	0%	1,457	£34.62	77.02	282.41
Community wood chip CHP	Flat	-2,185	£254.43	937.67	3,438.12	0%	-2,185	£254.43	937.67	3,438.12
Community ground source heat pumps	Flat	9,216	£11.47	148.80	545.61	0%	9,216	£11.47	148.80	545.61
Community heating with wood chip	Flat	-1,135	£79.40	1,034.11	3,791.73	0%	-1,135	£79.40	1,034.11	3,791.73
CFLs – retail		8	£2.08	2.20	8.07	0%	8	£2.08	2.20	8.07
CFLs – direct		8	£2.08	2.20	8.07	0%	8	£2.08	2.20	8.07
Efficient halogens		3	£0.83	0.88	3.24	0%	3	£0.83	0.88	3.24
Appliances – Cold		37	£6.40	7.16	26.26	0%	37	£6.40	7.16	26.26
Appliances – Wet		102	£9.46	12.16	44.58	0%	102	£9.46	12.16	44.58
Appliances – iDTVs		27	£5.39	5.91	21.65	0%	27	£5.39	5.91	21.65
PC mains panels		39	£7.86	8.61	31.58	0%	39	£7.86	8.61	31.58
Energy saving		10	£2.10	2.30	8.42	0%	10	£2.10	2.30	8.42

		Gross savings					Net savings			
Measure	**Comments on the size of property assumed**	**Energy MWh/yr**	**Fuel Cost £/yr**	**Carbon, kgC/yr**	**Carbon dioxide kgCO2/yr**	**Comfort factor**	**Energy MWh/yr**	**Fuel Cost £/yr**	**Carbon, kgC/yr**	**Carbon dioxide kgCO2/y**
kettles										
LNBs		7	£1.50	1.64	6.01	0%	7	£1.50	1.64	6.01
Wood pellet stoves (secondary)	3 bed semi	313	-£42.17	163.99	601.31	0%	313	-£42.17	163.99	601.31
Log burning stoves	3 bed semi	-482	-£13.05	58.90	215.98	0%	-482	-£13.05	58.90	215.98
Wood pellet boilers (primary)	3 bed semi	2,103	-£93.17	1,415.94	5,191.77	0%	2,103	-£93.17	1,415.94	5,191.77
Solar Water Heater (4m²)		1,548	£40.81	88.85	325.78	0%	1,548	£40.81	88.85	325.78
Ground source heat pumps	3 bed semi	10,720	£239.26	708.95	2,599.50	0%	10,720	£239.26	708.95	2,599.50
Micro Wind (1 kWp, 10% LF)		877	£79.68	103.00	377.67	0%	877	£79.68	103.00	377.67
Mini-wind 5 kW, 20% LF		8,766	£807.40	1,030.01	3,776.69	0%	8,766	£807.40	1,030.01	3,776.69
Micro Hydro (0.7kWp, 50% LF)		3,068	£278.89	360.50	1,321.84	0%	3,068	£278.89	360.50	1,321.84
Photovoltaic panels (2.5 kWp)		2,115	£192.25	248.51	911.21	0%	2,115	£192.25	248.51	911.21
mCHP		-1,286	£97.85	57.30	210.12	0%	-1,286	£97.85	57.30	210.12

For all insulation measures, the carbon dioxide savings depend on the heating system, being higher for a carbon intensive fuel such as electricity than for a less intensive fuel, such as gas. For each measure, the carbon dioxide savings have been calculated for each of 7 heating system types[23]. For insulation, the figures above are weighted averages according to the GB stock average.

However, for heating measures (eg heat pumps, biomass boilers etc), the figures given above for these measures are based on Defra's best estimate of the mix of heating systems that might be displaced. For example, in the above calculation, it has been assumed that community ground source heat pumps will mostly be installed in new build housing estates, and therefore, that the default heating system would have been gas. On the other hand, it has been assumed that heat pumps for individual dwellings will mostly be installed off the gas grid, and so the carbon dioxide savings shown above refer to a weighted average of off gas grid heating systems. The figures above are therefore illustrative only. More details on the calculation of carbon dioxide savings from microgeneration and community heating are given in Annex C.

[23] The 7 heating types considered are: gas central heating, electric storage heating, oil central heating, gas non-central heating, electric non-central heating and solid fuel non-central heating.

Table 2: Lifetime carbon/CO2 savings for the average 3-bed semi-detached house – the CERT 'scores' (weighted average over all fuels).

Measure	Lifetime	Lifetime carbon saving per measure installed tC	Lifetime CO2 saving per measure installed , tC	Comments on the size of property assumed
Cavity wall insulation	40	6.92	25.37	3 bed semi
Loft insulation (professional)	40	3.42	12.53	3 bed semi
Loft insulation (DIY)	40	2.93	10.75	3 bed semi
SWI external to U of 0.35W/m2K	30	18.08	66.30	3 bed semi
SWI internal to U of 0.45W/m2K	30	17.10	62.69	3 bed semi
Insulated wallpaper	30	5.88	21.56	3 bed semi
Tank insulation - top-up	10	0.46	1.68	3 bed semi
Draughtproofing	20	0.72	2.66	3 bed semi
Glazing E to C rated	20	0.45	1.64	3 bed semi
A/B rated boilers (exceptions)	12	1.17	4.28	3 bed semi
Fuel Switching	20	22.15	81.22	3 bed semi
Heating controls - upgrade with boiler	12	0.11	0.42	3 bed semi
Heating controls - extra	12	0.92	3.39	3 bed semi
Wood chip CHP	30	28.13	103.14	Flat
Community ground source heat pumps	40	5.95	21.82	Flat
Community heating with wood chip	30	31.02	113.75	Flat
CFLs - retail	17.7	0.04	0.14	
CFLs - direct	17.7	0.04	0.14	
Efficient halogens	6.51	0.01	0.02	
Appliances - Cold	12	0.09	0.32	
Appliances - Wet	12	0.15	0.53	
Appliances - iDTVs	7	0.04	0.15	
PC mains panels	15	0.13	0.47	
Energy saving kettles	5	0.01	0.04	
LNBs	7	0.01	0.04	
Wood pellet stoves (secondary)	20	3.28	12.03	3 bed semi
Log burning stoves	20	1.18	4.32	3 bed semi
Wood pellet boilers (primary)	20	28.32	103.84	3 bed semi
Solar Water Heater (4m²)	25	2.22	8.14	
Ground source heat pumps	40	28.36	103.98	3 bed semi
micro Wind (1 kWp, 10%	10	1.03	3.78	

LF)				
Mini-wind 5 kW, 20% LF	22.5	23.18	84.98	
micro Hydro (0.7kWp, 50% LF)	20	7.21	26.44	
Photovoltaic panels (2.5 kWp)	25	6.21	22.78	
mCHP	15	0.86	3.15	3 bed semi

Energy prices were provided by BERR, based on information from the 2nd quarter of 2007 (see Table 3, which also shows the fuel carbon dioxide intensity figures that were used)[24]. Prices for electric space and water heating and heat pumps assume an average cost per kWh derived from an appropriate proportion of on-peak and off-peak electricity.

[24] BERR "Quarterly Energy Prices", June 2007 http://www.berr.gov.uk/files/file40157.pdf

Table 3: Carbon content, carbon dioxide content and retail prices (including VAT) for each fuel type

Fuel type	kgC/kWh	kgCO2/kWh	p/kWh
For individual dwellings			
Gas	0.0518	0.1899	2.32
Electricity (standard)	0.1175	0.4308	9.09
Electricity (on peak)	0.1175	0.4308	9.95
Electricity (off peak)	0.1175	0.4308	3.77
Oil	0.0680	0.2493	3.17
Coal	0.0817	0.2996	2.65
Logs	0.0068	0.0249	2.61
Wood chips	0.0068	0.0249	1.90
Pellets (bags)	0.0068	0.0249	5.94
Pellets (bulk)	0.0068	0.0249	3.57
For community heating			
Gas	0.0518	0.1899	2.83
Oil	0.0680	0.2493	3.71
Coal	0.0817	0.2996	3.17
Wood chips	0.0068	0.0249	2.39
Pellets (bulk)	0.0068	0.0249	4.13

Fuel prices include VAT (at 5%) when calculating fuel cost saving benefits to consumers (this is included in the tables above), but **exclude them when calculating the overall net present value and cost-effectiveness of the scheme**.

A discount rate of 3.5% is applied to future financial benefits in line with Treasury's Green Book. Future carbon dioxide savings (used to calculate lifetime carbon dioxide savings) are not discounted.

In addition we take account of the difference in dwelling size for PG and non-PG homes compared with the average 3-bed semi-detached house as shown in Table 4. Based on EHCS data for floor area, which we assume to be representative of the whole of GB, dwellings of households on benefits are 15% smaller, while those of other householders are 7% larger than the average. Making an adjustment for the fact that the PG has been expanded to include all households for which at least one member is over the age of 70, an average PG dwelling is assumed to be 12.5% smaller, and an average non-PG dwelling to be 7.8% larger than the average, i.e. the two groups have floor area factors of 87.5% and 107.8% respectively.

A geometric factor is applied as appropriate for each measure. The corrected saving = (saving of a 3-bed semi) x (floor area factor)^(rate of variation with dwelling area). A value of 1 for the rate of variation means the saving is linearly proportional to floor area; a value of 0 means it is independent of floor area. Note that some of the electric/electronic apparatus shows a variation with floor area. This is because of the heat replacement effect, whereby lower energy use by the appliance means that the heating system will use more fuel to warm the room to the same temperature.

Table 4: Net savings for average 3-bed semi-detached, PG and non-PG dwellings (the floor area of PG dwellings is assumed to be 87.5% of the average 3-bed semi, and 107.8% for non-PG dwellings)

Measure	Average 3-bed semi-detached			Rate of variation with dwelling area	Annual fuel cost savings (£/yr)		Annual carbon dioxide savings (tCO_2/yr)		Lifetime carbon dioxide savings (tCO_2)	
	Annual fuel cost savings (£/yr)	Annual carbon dioxide savings (tCO_2/yr)	Lifetime carbon dioxide savings (tCO_2)		PG	non-PG	PG	non-PG	PG	non-PG
Cavity wall insulation	£77.86	0.63	25.37	0.5	£73.29	£80.54	0.60	0.66	23.88	26.25
Loft insulation (professional)	£38.41	0.31	12.53	1.0	£34.04	£41.10	0.28	0.34	11.11	13.41
Loft insulation (DIY)	£32.95	0.27	10.75	1.0	£29.19	£35.25	0.24	0.29	9.52	11.50
SWI external to U of 0.35W/m2K	£271.23	2.21	66.30	0.5	£255.30	£280.56	2.08	2.29	62.41	68.59
SWI internal to U of 0.45W/m2K	£256.45	2.09	62.69	0.5	£241.39	£265.27	1.97	2.16	59.01	64.85
Insulated wallpaper	£95.30	0.72	21.56	0.5	£89.71	£98.58	0.68	0.74	20.29	22.30
Tank insulation - top-up	£20.27	0.17	1.68	0.0	£20.27	£20.27	0.17	0.17	1.68	1.68
Draughtproofing	£16.30	0.13	2.66	1.0	£14.44	£17.44	0.12	0.14	2.35	2.84
Glazing E to C rated	£10.08	0.08	1.64	0.6	£9.37	£10.50	0.08	0.09	1.53	1.71
A/B rated boilers (exceptions)	£43.58	0.36	4.28	0.6	£40.53	£45.39	0.33	0.37	3.98	4.45
Fuel Switching	£502.19	4.06	81.22	0.6	£467.01	£522.99	3.78	4.23	75.53	84.58
Heating controls - upgrade with boiler	£4.30	0.04	0.42	0.7	£3.95	£4.51	0.03	0.04	0.39	0.44
Heating controls - extra	£34.62	0.28	3.39	0.7	£31.80	£36.29	0.26	0.30	3.11	3.55
Wood chip CHP	£254.43	3.44	103.14	0.5	£239.49	£263.18	3.24	3.56	97.09	106.69
Community ground source heat pumps	£11.47	0.55	21.82	0.5	£10.79	£11.86	0.51	0.56	20.54	22.58
Community heating with wood chip	£79.40	3.79	113.75	0.5	£74.74	£82.13	3.57	3.92	107.07	117.67
CFLs - retail	£2.08	0.01	0.14	0.0	£2.08	£2.08	0.01	0.01	0.14	0.14

Measure	Average 3-bed semi-detached			Rate of variation with dwelling area	Annual fuel cost savings (£/yr)		Annual carbon dioxide savings (tCO_2/yr)		Lifetime carbon dioxide savings (tCO_2)	
	Annual fuel cost savings (£/yr)	Annual carbon dioxide savings (tCO_2/yr)	Lifetime carbon dioxide savings (tCO_2)		PG	non-PG	PG	non-PG	PG	non-PG
CFLs - direct	£2.08	0.01	0.14	0.0	£2.08	£2.08	0.01	0.01	0.14	0.14
Efficient halogens	£0.83	0.00	0.02	0.0	£0.83	£0.83	0.00	0.00	0.02	0.02
Appliances - Cold	£6.40	0.03	0.32	0.5	£6.03	£6.62	0.02	0.03	0.30	0.33
Appliances - Wet	£9.46	0.04	0.53	0.5	£8.91	£9.79	0.04	0.05	0.50	0.55
Appliances - iDTVs	£5.39	0.02	0.15	0.5	£5.08	£5.58	0.02	0.02	0.14	0.16
PC mains panels	£7.86	0.03	0.47	0.3	£7.63	£8.00	0.03	0.03	0.46	0.48
Energy saving kettles	£2.10	0.01	0.04	0.3	£2.03	£2.13	0.01	0.01	0.04	0.04
LNBs	£1.50	0.01	0.04	0.0	£1.50	£1.50	0.01	0.01	0.04	0.04
Wood pellet stoves (secondary)	**-£42.17**	0.60	12.03	0.6	**-£39.22**	**-£43.92**	0.56	0.63	11.18	12.52
Log burning stoves	**-£13.05**	0.22	4.32	0.5	**-£12.29**	**-£13.50**	0.20	0.22	4.07	4.47
Wood pellet boilers (primary)	**-£93.17**	5.19	103.84	0.6	**-£86.64**	**-£97.03**	4.83	5.41	96.56	108.14
Solar Water Heater ($4m^2$)	£40.81	0.33	8.14	0.0	£40.81	£40.81	0.33	0.33	8.14	8.14
Ground source heat pumps	£239.26	2.60	103.98	0.6	£222.50	£249.17	2.42	2.71	96.70	108.29
Micro Wind (1 kWp, 10% LF)	£79.68	0.38	3.78	0.0	£79.68	£79.68	0.38	0.38	3.78	3.78
Mini-wind 5 kW, 20% LF	£807.40	3.78	84.98	0.0	£807.40	£807.40	3.78	3.78	84.98	84.98
Micro Hydro (0.7kWp, 50% LF)	£278.89	1.32	26.44	0.0	£278.89	£278.89	1.32	1.32	26.44	26.44
Photovoltaic panels (2.5 kWp)	£192.25	0.91	22.78	0.0	£192.25	£192.25	0.91	0.91	22.78	22.78
mCHP	£97.85	0.21	3.15	0.6	£90.99	£101.90	0.20	0.22	2.93	3.28

Costs of Measures

Costs are estimated as part of the Impact Assessment (IA). In this context, we are attempting to estimate the maximum potential cost that could be passed on to consumers as suppliers work to meet their targets. Our estimated costs are therefore not intended to necessarily reflect the actual costs borne by energy suppliers (as energy suppliers may be able to deliver their targets more cost-effectively) or the level of cost they may choose to pass through to their customers. Suppliers are not required to report any costs – they are commercially sensitive as CERT operates in a competitive market. Estimates are based on knowledge of the relevant markets.

Our estimated costs are made up of the direct installation cost of the measure and the indirect costs (e.g. administration and marketing) related to that measure's promotion and installation. The total cost is assumed to be split between the energy supply company, the householder and, for measures installed in social housing, the social housing provider. The contribution from each, as a proportion, is listed for each measure both for the priority and non-priority groups. In most cases, the proportion of cost met by the priority group is assumed to be lower than for the non-priority group. These contributions are based on EEC1 outturns[28] – see the tables below (Table 5 and Table 6) for details of cost assumptions.

The remaining potential for the most cost-effective measures (particularly cavity wall insulation) in the social sector is diminishing, as a result of activities carried out under past schemes. Activity in the social sector is therefore considerably reduced for these measures compared with previous schemes. However, there are still substantial opportunities for some measures, including the more costly measures such as solid wall insulation and micro-generation, being co-financed by local authorities and social landlords. Table 6 shows the estimated proportion of each measure in social housing.

The installation costs assumed in the model are based on current prices, which are generally assumed to be 5% higher than those quoted in the EEC2 Illustrative Mix taking account of inflation. As described in section 0 Energy, *Fuel Cost & Carbon Dioxide Savings*, dwellings of PG households are assume to be 87.5% of the size of an average 3-bed semi-detached house, and 107.8% for non-PG households. For each measure, a certain fraction of the cost is assumed to be dependent on the size of the dwelling (as shown in Table 5).

Indirect costs are very difficult to estimate. Sometimes they are partially passed on by suppliers to contractors e.g. to include search costs and are quoted as part of the unit cost; however, in our analysis we assume that the unit cost consists only of the installation cost.

Indirect costs are assumed to be a percentage of the unit cost of the measure. A fixed percentage tends to give unrealistically high admin costs for expensive measures. Using bands (e.g. 20% if less than £500, 10% if more, etc.) leads to jumps where if a measure was cheaper by a small amount its administration cost would be nearly doubled. To avoid such discontinuities, the following empirical formula was used as the most practical way of assigning values.

% of unit cost = 250 / (unit cost + 1000)

The percentage is higher for low cost measures (reaching a maximum of 25% for the cheapest), but falls off exponentially as the cost increases. This means that the absolute indirect cost rises at an ever-slower rate as the unit cost increases. This gives an indirect cost of 20% at a unit cost of £250 and 10% at a cost of £1500. These estimates of indirect costs apply to the non-PG only; in the PG, the indirect costs are estimated to be around 23% higher than in the non-PG.

Some of the costs have changed compared to those published in the first draft Illustrative Mix:

- Administration costs have been increased for the PG.
- Cavity wall insulation is assumed to be 10% more expensive than previously estimated because we expect the market to tighten as industry capacity limits are approached.
- DIY loft insulation is assumed to have a slightly lower cost than previously assumed, since it appears not to have risen as fast as inflation since earlier phases of EEC.
- The cost assumed for wet appliances has been increased from £100 to £200 on the basis of a refined estimate from the Government's Market Transformation Programme. (This is the marginal cost of installing an A-rated tumble dryer.)
- For new heating systems, the cost given is the marginal cost (as compared to replacing the existing heating system). For example, the cost of a domestic micro-CHP unit is estimated as £600, which is the Carbon Trust's estimate of the marginal cost as compared to purchasing a new gas condensing boiler.
- Annual costs for heating systems are also marginal. Where installing the measure saves on annual costs, an annual cost of zero has been reported. For example, installing a heat pump in a property previously heated by oil will lead to lower annual maintenance costs, but these are reported as zero, rather than negative costs.
- For solar PV, the new build cost has been used. CERT can be used to support any renewables in new build that are not required by Building Regulations or local planning requirements (eg Merton Rule). Since installation costs for PV are often lower for new build properties than for retro-fit, we anticipate that the market is likely to be in this sector.

Table 5: Average costs of individual measures (the cost may depend to some degree on the size of the dwelling; the floor area of PG dwellings is assumed to be 87.5% of the average 3-bed semi, and 107.8% for non-PG dwellings)

Measure	Unit cost of measure (£) 3-bed semi-detached	Comments	Proportion of cost affected by dwelling area	Unit cost of measure (£)		Indirect costs (£)		Total cost (£)		Annual costs (£)
				Priority	Other	Priority	Other	Priority	Other	
Cavity wall insulation	£380.10	3 bed semi	0.5	£356.34	£394.84	£86.70	£70.77	£443.04	£465.61	£0
Loft insulation (professional)	£286.20	3 bed semi	0.5	£268.31	£297.30	£69.81	£57.29	£338.12	£354.59	£0
Loft insulation (DIY)	£120.00	3 bed semi	0.9	£106.50	£128.38	£31.76	£28.44	£138.26	£156.82	£0
SWI external	£4,500.00	3 bed semi	0	£4,218.75	£4,674.52	£266.77	£205.94	£4,485.52	£4,880.47	£0
SWI internal	£3,000.00	3 bed semi	0	£2,812.50	£3,116.35	£243.44	£189.27	£3,055.94	£3,305.62	£0
Insulated wallpaper	£1,660.00	3 bed semi	0.75	£1,556.25	£1,724.38	£200.90	£158.24	£1,757.15	£1,882.62	£0
Tank insulation - top-up	£13.80	3 bed semi	0.1	£13.80	£13.80	£4.49	£3.40	£18.29	£17.20	£0
Draughtproofing	£100.70	3 bed semi	0.1	£94.41	£104.61	£28.47	£23.67	£122.87	£128.28	£0
Glazing E to C rated	£212.00	3 bed semi	0.5	£198.75	£220.22	£54.71	£45.12	£253.46	£265.34	£0
A/B rated boilers (exceptions)	£212.00	3 bed semi	0.5	£209.35	£213.64	£57.13	£44.01	£266.48	£257.65	£0
Fuel Switching	£2,014.00	3 bed semi	0.5	£1,888.13	£2,092.11	£215.74	£169.15	£2,103.86	£2,261.26	£50
Heating controls - upgrade with boiler	£90.10	3 bed semi	0	£84.47	£93.59	£25.70	£21.40	£110.17	£114.99	£0
Heating controls - extra	£148.40	3 bed semi	0.5	£139.13	£154.16	£40.30	£33.39	£179.43	£187.55	£0
Wood chip CHP	£9,281.00	per flat	0.1	£9,164.99	£9,352.99	£297.54	£225.85	£9,462.52	£9,578.84	£0
Community GSHP	£4,250.00	per flat	0.1	£4,196.8	£4,282.9	£266.50	£202.68	£4,463.3	£4,485.6	£0

Measure	Unit cost of measure (£) 3-bed semi-detached	Comments	Proportion of cost affected by dwelling area	Unit cost of measure (£)		Indirect costs (£)		Total cost (£)		Annual costs (£)
				Priority	Other	Priority	Other	Priority	Other	
				8	7			8	4	
Community heating to wood chip	£350.00	per flat	0.1	£345.63	£352.71	£84.76	£65.19	£430.39	£417.90	£0
CFLs - retail	£2.10		0.5	£2.10	£2.10	£0.69	£0.52	£2.79	£2.62	£0
CFLs - direct	£3.20		0.1	£3.20	£3.20	£1.05	£0.80	£4.25	£4.00	£0
Efficient halogens	£2.50		0	£2.50	£2.50	£0.82	£0.62	£3.32	£3.12	£0
Appliances - Cold	£21.20		0.5	£21.20	£21.20	£6.85	£5.19	£28.05	£26.39	£0
Appliances - Wet	£200.00		0.5	£200.00	£200.00	£55.00	£41.67	£255.00	£241.67	£0
Appliances - iDTVs	£1.50		0.5	£1.50	£1.50	£0.49	£0.37	£1.99	£1.87	£0
PC mains panels	£35.00		0	£35.00	£35.00	£11.16	£8.45	£46.16	£43.45	£0
Energy saving kettles	£17.00		0	£17.00	£17.00	£5.52	£4.18	£22.52	£21.18	£0
LNBs	£10.00		0.5	£10.00	£10.00	£3.27	£2.48	£13.27	£12.48	£0
Wood pellet stoves (secondary)	£1,417.00	3 bed semi	0.1	£1,399.29	£1,427.99	£192.46	£147.03	£1,591.75	£1,575.03	£0
Log burning stoves	£1,000.00	3 bed semi	0	£987.50	£1,007.76	£163.96	£125.48	£1,151.46	£1,133.24	£60
Wood pellet boilers (primary)	£7,200.00	3 bed semi	0	£7,110.00	£7,255.85	£289.31	£219.72	£7,399.31	£7,475.57	£60
Solar Water Heater (4m²)	£3,500.00	3 bed semi	0	£3,500.00	£3,500.00	£256.67	£194.44	£3,756.67	£3,694.44	£15
Ground source heat pumps	£11,360.00	3 bed semi	0	£10,295.00	£12,020.87	£300.78	£230.80	£10,595.78	£12,251.67	£0
micro Wind (1 kWp, 10% LF)	£3,200.00		0	£3,200.00	£3,200.00	£251.43	£190.48	£3,451.43	£3,390.48	£29

Measure	Unit cost of measure (£) 3-bed semi-detached	Comments	Proportion of cost affected by dwelling area	Unit cost of measure (£)		Indirect costs (£)		Total cost (£)		Annual costs (£)
				Priority	Other	Priority	Other	Priority	Other	
Mini-wind 5 kW, 20% LF	£21,000.00		0.1	£21,000.00	£21,000.00	£315.00	£238.64	£21,315.00	£21,238.64	£200
micro Hydro (0.7kWp, 50% LF)	£1,890.00		0	£1,890.00	£1,890.00	£215.81	£163.49	£2,105.81	£2,053.49	£19
Photovoltaic panels (2.5 kWp)	£6,337.50		0	£6,337.50	£6,337.50	£285.03	£215.93	£6,622.53	£6,553.43	£63
mCHP	£600.00		0	£562.50	£623.27	£118.80	£95.99	£681.30	£719.26	£0

Note that many local authorities have already insulated most of the cavities and lofts in the social housing stock. For this reason, the assumed levels of cavity insulation and loft insulation in the social sector are low.

Table 6 : Expected proportion of measures in social housing

Measure	Assume proportion of installations in social housing
Cavity wall insulation	5%
Loft insulation (professional)	10%
Loft insulation (DIY)	0%
SWI external	64%
SWI internal	65%
Insulated wallpaper	67%
Tank insulation - top-up	0%
Draughtproofing	10%
Glazing E to C rated	40%
A/B rated boilers (exceptions)	40%
Fuel Switching	20%
Heating controls - upgrade with boiler	20%
Heating controls - extra	20%
Wood chip CHP	95%
Community GSHP	67%
Community heating to wood chip	91%
CFLs - retail	0%
CFLs - direct	0%
Efficient halogens	0%
Appliances - Cold	0%
Appliances - Wet	0%
Appliances - iDTVs	0%
PC mains panels	0%
Energy saving kettles	0%
LNBs	0%
Wood pellet stoves (secondary)	0%
Log burning stoves	0%
Wood pellet boilers (primary)	0%
Solar Water Heater (4m²)	38%
Ground source heat pumps	0%
Micro Wind (1 kWp, 10% LF)	0%
Mini-wind 5 kW, 20% LF	0%
Micro Hydro (0.7kWp, 50% LF)	0%
Photovoltaic panels (2.5 kWp)	0%
mCHP	67%

Note that the suppliers' cost contributions for some measures in the PG are very high – for example, mini-wind. For this reason, it has been assumed that many microgeneration measures are installed in the non-PG only.

Table 7: Cost contributions for individual measures

Measure	% of unit cost met by supplier		Total cost to supplier (£)		Cost met by householder (£)		Cost to social housing provider (£)	
	Priority	Other	Priority	Other	Priority	Other	Priority	Other
Cavity wall insulation	90%	56%	20	5	398	262	25	199
Loft insulation (professional)	89.1%	64.3%	25	9	301	228	11	118
Loft insulation (DIY)	33.4%	35.9%	0	0	46	56	92	101
SWI external	85.0%	46.7%	673	434	3,813	2,278	0	2,169
SWI internal	81.3%	45.5%	573	384	2,483	1,505	0	1,417
Insulated wallpaper	75.0%	38.3%	439	157	1,318	722	0	1,004
Tank insulation - top-up	95.1%	80.4%	0	0	17	14	1	3
Draughtproofing	93.3%	76.0%	7	5	115	97	1	26
Glazing E to C rated	74.8%	50.0%	57	40	189	133	7	93
A/B rated boilers (exceptions)	56.9%	76.2%	113	20	152	196	2	41
Fuel Switching	86.5%	51.3%	281	129	1,820	1,161	3	971
Heating controls - upgrade with boiler	74.6%	43.3%	17	6	82	50	11	59
Heating controls - extra	74.6%	43.3%	27	9	134	81	19	97
Wood chip CHP	50.0%	49.1%	4,731	3,991	4,731	4,708	0	880
Community GSHP	50.0%	46.6%	2,232	748	2,232	2,090	0	1,649
Community heating to wood chip	75.0%	66.5%	108	75	323	278	0	65
CFLs - retail	41.4%	43.0%	0	0	1	1	2	1
CFLs - direct	98.9%	83.1%	0	0	4	3	0	1
Efficient halogens	50.0%	20.0%	2	0	2	1	0	2
Appliances - Cold	56.7%	51.5%	0	0	16	14	12	13
Appliances - Wet	49.8%	51.0%	0	0	127	123	128	118
Appliances - iDTVs	50.0%	50.0%	0	0	1	1	1	1
PC mains panels	50.0%	50.0%	0	0	23	22	23	22
Energy saving kettles	50.0%	50.0%	0	0	11	11	11	11
LNBs	87.5%	50.0%	0	0	12	6	2	6
Wood pellet stoves (secondary)	75.0%	20.0%	398	0	1,194	315	0	1,260
Log burning stoves	75.0%	20.0%	288	0	864	227	0	907
Wood pellet boilers (primary)	75.0%	30.0%	1,850	0	5,549	2,243	0	5,233
Solar Water Heater (4m²)	75.0%	27.3%	939	123	2,818	1,010	0	2,561
Ground source heat pumps	50.0%	20.0%	5,298	0	5,298	2,450	0	9,801

Measure	% of unit cost met by supplier		Total cost to supplier (£)		Cost met by householder (£)		Cost to social housing provider (£)	
	Priority	Other	Priority	Other	Priority	Other	Priority	Other
micro Wind (1 kWp, 10% LF)	75.0%	20.0%	863	0	2,589	678	0	2,712
Mini-wind 5 kW, 20% LF	50.0%	20.0%	10,658	0	10,658	4,248	0	16,991
micro Hydro (0.7kWp, 50% LF)	75.0%	20.0%	526	0	1,579	411	0	1,643
Photovoltaic panels (2.5 kWp)	75.0%	20.0%	1,656	0	4,967	1,311	0	5,243
mCHP	75.0%	54.9%	170	60	511	395	0	264

Number of installations

The number of installations for each measure is shown in the main Illustrative Mix table below (Table 8).

The number of installations takes account of what in our view would be the cost-effectiveness for suppliers, prioritising the most cost-effective measures from their perspective.

An estimate was made in each case of the maximum number of installations for the CERT period. Several limiting factors were identified and quantified:

- The remaining technical potential (i.e. how many homes, which could have the measure, remain without it)
- The maximum number of installations that physically could be installed during the 3 year period (i.e. the maximum capacity of the relevant installation or manufacturing industry)
- The likely limit of consumer demand for the measure

For each measure, the lowest of these factors would be the limiting one and this was noted as the maximum possible for the CERT target setting exercise.

For cavity wall insulation, the most important measure, we assume a total of 2.9 million installations under CERT, including 180,000 installations[25] that suppliers committed to carry-over and install prior to April 2008, making use of the unlimited carry-over arrangements as announced in the 2006 Budget. The maximum number of CWI installations is limited by the capacity of the insulation industry; Defra commissioned ESD to review the insulation industry supply chain (first in 2005 with an updated review in Feb. 2007) and they concluded that the projected maximum capacity for the 3-year CERT period is 3.0m CWI installations.[26]

For the Priority Group, the number of CWI installations is limited by the remaining potential. Taking account of churn due to people moving house and more importantly moving in and out of the Priority Group, we estimate that under CERT, around half of the remaining fillable but unfilled cavities in the Priority Group will be filled. The corresponding figure for the non-Priority Group is around 35%. See Note B for further details.

We assume that there might be 2.1m professional installations of loft insulation, plus a further 600,000 DIY installations. This is well within the maximum industry capacity of more than 1m per annum as identified in ESD's study on the insulation industry supply chain.

CFLs remain fairly cost-effective and we assume a total of 110m CFLs, partly via retail, partly via direct mail out.

[25] We assume that the carry-over commitments of 300,000 insulation measures is split 60:40 between cavity wall and loft insulation.

[26] UK Insulation Sector Supply Chain Review, ESD, February 2007, www.defra.gov.uk/environment/energy/eec/pdf/supply-chain-review.pdf

Following consultation, the fuel switching figures have been revised downwards. The figures in the revised mix reflect the numbers proposed by suppliers for EEC2. Ofgem is currently consulting on proposals to make it easier for suppliers to undertake fuel switching[27].

Instant feedback devices such as handheld display units are potentially attractive in terms of cost-effectiveness. However, such monitors will be mandated for electricity (see Energy White Paper 2007), and hence they are not eligible under CERT. We have therefore not included any of these devices in the Illustrative Mix.

Estimating the number of installations for micro-generation technologies is particularly difficult as these are often young markets with relatively large uncertainties. Suppliers may also be interested in promoting these technologies for marketing and strategic reasons other than CERT cost-effectiveness considerations. In any case we expect that the contribution by micro-generation technologies will be relatively small compared to the CERT target. However, conversely CERT support could potentially significantly contribute to the market transformation of these technologies. More details on micro-generation are included in Note C.

For retail schemes, the proportion of installations in the Priority Group is assumed to be the same as under EEC1 (based on EEC1 outturn)[28].

Outcomes

Table 8 below shows the final Illustrative Mix of measures with the number of installations (including deadweight), and annual and lifetime carbon dioxide savings for each measure and in total. The overall lifetime carbon dioxide savings (including deadweight installations), in other words the target for CERT is 154 $MtCO_2$ lifetime savings. The lifetime carbon dioxide savings net of deadweight are 132 $MtCO_2$. The corresponding net annual savings at the end of the programme are about 4.23 $MtCO_2$[29].

Table 9 shows various key outputs including costs and benefits.

Costs to Suppliers

The overall cost to suppliers is estimated to be about £2.76 billion or about £105 per household for the 3 years. This equates to £35 per year or around 4.5% of energy bills, if passed on in full.

This is around £20 per household for the 3 years (or 2.5% of energy bills) on top of current EEC2 costs and today's energy bills**. The costs of CERT to suppliers are around 2.3 times the EEC2 costs (which are estimated as £1.2bn). To understand the main factor in this, doubling the CERT net carbon dioxide saving – with no**

[27] Ofgem consultation "Gas Distribution Price Control Review- Initial Proposals Document", May 2007

[28] Evaluation of the Energy Efficiency Commitment 2002-05, Eoin Lees Energy 2006, www.defra.gov.uk/environment/energy/eec/pdf/eec-evaluation.pdf

[29] The Obligation is set in terms of tonnes of carbon dioxide, which is in line with Defra policy. In previous policies, the units were tonnes of carbon. The figures above translate as follows: 154 MtCO2 = 42 MtC; 132 MtCO2=36 MtC; 4.23 MtCO2=1.15 MtC.

other changes – is likely to increase EEC2 cost by around 80-90%, once the effect of deadweight is accounted for. A second factor is much reduced contribution from the social sector, since the remaining potential for many measures in this sector will be small by the end of EEC2. This has a substantial impact on supplier costs in the PG, although with a proportionally smaller impact on overall costs. A third factor is the move towards more expensive measures, due to capacity and demand constraints on the three major measures, cavity wall insulation, loft insulation and fuel switching. Together with other smaller changes, some of which could decrease costs and others increase them, the overall effect is close to a factor of 2.3.

Administration and implementation costs now account for £625m or 23% of suppliers' costs, or 14.5% of total costs.

Benefits

CERT is very cost effective, with net benefits of around £49/tCO_2 (which equates to £179/tC).

At the household level, the annual costs could be about £35 per year for 3 years. However, average benefits build up to a similar level by the end of the 3rd year, and thereafter continue for around 30 years on average (the major measures have quoted lifetimes of 40 years). The PG, which constitutes around 40% of household numbers, receives about 40% of the lifetime net benefits. Well over 50% of suppliers' costs are spent on the PG.

The overall net present value of the programme is a benefit of about £7.5bn or more than £10.7bn if the shadow price of carbon is included[30]. The maximum cost to suppliers, which they may pass on to their customers via energy bills, is estimated to be about £105 over the CERT period per household, while households benefit by over £436 on average over the lifetime of the measures (taking account of their own contribution to the cost but excluding the impact on fuel bills).

Implications for key measures

The most important measures are cavity wall and loft insulation, which together provide nearly 70% of the target score (lifetime carbon dioxide savings) and more than half of the annual carbon dioxide savings. Fuel switching and CFLs are the other important measures, with about 8% and 10% respectively of the lifetime score.

Priority group share

The priority group share is 40% of the target. Our analysis shows that this is the maximum practical potential; in other words, it is challenging but achievable. It is based on the number of installations that may be delivered in the PG as shown in the Illustrative Mix (Table 8). As in the Illustrative Mix more generally, cavity wall

[30] The Shadow Price of Carbon reflects the damage costs of climate change caused by each additional tonne of greenhouse gas emitted. See Defra guidance note "How to use the shadow price of carbon in policy appraisal", 30/10/2007 http://defraweb/environment/climatechange/research/carboncost/step1.htm

insulation is the most important measure for the priority group. The remaining potential in the priority group is limited to about 2.38 million cavities as described earlier (see Section 0) and in Note B. Other important measures are loft insulation and fuel switching followed by CFLs.

The social sector is very attractive for suppliers as the proportion of priority group households is high (with about three quarters of households in the social sector being in the priority group) and local authorities and social landlords often provide co-financing. Although (as discussed in Section 0) the remaining potential for the most cost-effective measures in the social sector is diminishing, there are still substantial opportunities for some measures, including the more costly measures such as solid wall insulation and micro-generation.

Table 8: Draft Illustrative Mix of measures showing the number of installations and business-as-usual deadweight (DW) installations, cost-effectiveness (C-E) ranking, lifetime carbon dioxide saving score, and annual carbon dioxide savings (net of comfort taking)

	Number of measures			Annual carbon dioxide savings (net of comfort taking, tC02/yr)			Lifetime carbon dioxide savings (net of comfort taking, tC02)			Suppliers' cost to save 1tC02 (£/tC02)		Ranking of cost effectiveness to suppliers	
Carbon saving measure	**PG**	**Non-PG**	**Total**	**PG**	**Non-PG**	**Total**	**PG**	**Non-PG**	**Total**	**PG**	**non-PG**	**PG**	**non-PG**
Cavity wall insulation	1,225,000	1,675,000	2,900,000	0.670	1.009	1.678	29.076	44.120	73.196	17	10	6	6
Loft insulation (professional)	1,050,000	1,050,000	2,100,000	0.265	0.312	0.577	11.516	14.182	25.698	27	17	8	9
Loft insulation (DIY)	75,000	525,000	600,000	0.000	0.113	0.113	0.705	6.082	6.787	5	5	**2**	**2**
SWI external to U of 0.35W/m2K	32,000	18,000	50,000	0.066	0.041	0.107	1.985	1.239	3.224	61	33	20	19
SWI internal to U of 0.45W/m2K	65,000	35,000	100,000	0.127	0.076	0.203	3.812	2.278	6.090	42	23	11	13
Insulated wallpaper	1,000	1,000	2,000	0.001	0.001	0.001	0.020	0.022	0.043	65	32	21	18
Tank insulation - top-up	150,000	150,000	300,000	0.025	0.023	0.047	0.296	0.296	0.593	9	7	**5**	**4**
Draughtproofing	100,000	50,000	150,000	0.012	0.007	0.019	0.232	0.143	0.376	49	34	15	20
Glazing E to C rated	150,000	75,000	225,000	0.011	0.006	0.018	0.227	0.129	0.356	125	77	24	27
A/B rated boilers (exceptions)	60,000	110,000	170,000	0.020	0.041	0.061	0.237	0.492	0.729	38	44	10	22
Fuel Switching	90,000	70,000	160,000	0.170	0.015	0.185	6.747	5.946	12.693	24	14	7	7

	Number of measures			Annual carbon dioxide savings (net of comfort taking, tC02/yr)			Lifetime carbon dioxide savings (net of comfort taking, tC02)			Suppliers' cost to save 1tC02 (£/tC02)		Ranking of cost effectiveness to suppliers	
Carbon saving measure	**PG**	**Non-PG**	**Total**	**PG**	**Non-PG**	**Total**	**PG**	**Non-PG**	**Total**	**PG**	**non-PG**	**PG**	**non-PG**
Heating controls - upgrade with boiler	100,000	100,000	200,000	0.003	0.004	0.007	0.038	0.044	0.083	214	112	28	28
Heating controls - extra	200,000	200,000	400,000	0.051	0.060	0.111	0.617	0.714	1.331	43	23	13	12
Wood chip CHP	1,000	400	1,400	0.003	0.001	0.005	0.096	0.043	0.139	49	44	14	23
Community ground source heat pumps	500	500	1,000	0.000	0.000	0.000	0.002	0.002	0.003	697	588	35	35
Community heating with wood chip	11,200	5,200	16,400	0.040	0.020	0.060	1.192	0.614	1.806	3	2	**1**	**1**
CFLs - retail	11,220,000	73,780,000	85,000,000	0.071	0.566	0.637	1.602	10.533	12.135	8	8	**4**	**5**
CFLs - direct	20,000,000	5,000,000	25,000,000	0.122	0.000	0.122	2.855	0.714	3.569	29	23	9	14
Efficient halogens	0	3,900,000	3,900,000	0.000	0.013	0.013	0.000	0.082	0.082	79	30	22	17
Appliances - Cold	372,000	1,628,000	2,000,000	0.009	0.044	0.054	0.110	0.533	0.642	54	42	17	21
Appliances - Wet	22,680	97,320	120,000	0.001	0.005	0.005	0.011	0.054	0.065	254	222	30	33
Appliances - iDTVs	150,000	850,000	1,000,000	0.003	0.019	0.022	0.021	0.134	0.155	7	6	**3**	**3**
PC mains panels	150,000	2,750,000	2,900,000	0.005	0.088	0.093	0.069	1.327	1.396	50	45	16	24

	Number of measures			Annual carbon dioxide savings (net of comfort taking, tC02/yr)			Lifetime carbon dioxide savings (net of comfort taking, tC02)			Suppliers' cost to save 1tC02 (£/tC02)		Ranking of cost effectiveness to suppliers	
Carbon saving measure	**PG**	**Non-PG**	**Total**	**PG**	**Non-PG**	**Total**	**PG**	**Non-PG**	**Total**	**PG**	**non-PG**	**PG**	**non-PG**
Energy saving kettles	75,000	200,000	275,000	0.001	0.002	0.002	0.003	0.009	0.012	276	247	32	34
LNBs	0	500,000	500,000	0.000	0.003	0.003	0.000	0.021	0.021	276	148	31	31
Wood pellet stoves (secondary)	0	250	250	0.000	0.000	0.000	0.000	0.003	0.003	126	29	26	16
Log burning stoves	0	250	250	0.000	0.000	0.000	0.000	0.002	0.002	110	26	23	15
Wood pellet boilers (primary)	0	3,000	3,000	0.000	0.016	0.016	0.000	0.326	0.326	58	21	18	11
Solar Water Heater ($4m^2$)	20,000	50,000	70,000	0.007	0.016	0.023	0.163	0.407	0.570	346	124	33	30
Ground source heat pumps	0	13,000	13,000	0.000	0.046	0.046	0.000	1.838	1.838	42	17	12	10
Micro Wind (1 kWp, 10% LF)	0	100	100	0.000	0.000	0.000	0.000	0.000	0.000	685	180	34	32
Mini-wind 5 kW, 20% LF	0	250	250	0.000	0.001	0.001	0.000	0.021	0.021	125	50	25	25
Micro Hydro (0.7kWp, 50% LF)	0	50	50	0.000	0.000	0.000	0.000	0.001	0.001	60	16	19	8
Photovoltaic panels (2.5 kWp)	0	300	300	0.000	0.000	0.000	0.000	0.007	0.007	218	58	29	26
mCHP	200	200	400	0.000	0.000	0.000	0.001	0.001	0.001	176	120	27	29

Table 9: Key Results of the Illustrative Mix of Measures

Overall results of scheme				
Benefits:	**PG**	**Non-PG**	**Total**	**%PG**
Annual carbon dioxide saving net of deadweight (MtC02/yr)	1.68	2.55	4.23	40%
Lifetime carbon dioxide saving (MtC02)	61.63	92.36	154.00	40%
Lifetime carbon dioxide saving net of deadweight (MtC02)	53.28	78.39	131.68	40%
Annual fuel cost savings without any reduction for comfort taking. VAT included (£m/yr)	306.1	518.0	824.1	37%
Annual fuel cost savings without any reduction for comfort taking and net of deadweight	255.6	439.1	694.7	37%
Annual fuel cost savings after reduction for comfort taking. VAT included (£m/yr)	279.03	480.33	759.36	37%
Annual fuel cost savings net of deadweight and after reduction for comfort taking. VAT included. (£m/yr)	230.67	405.19	635.87	36%
Discounted lifetime fuel cost savings, no reduction for comfort taking (£m)	5,377	8,668	14,045	38%
Disoucnted lifetime fuel cost savings, no reduction for comfort taking, and net of deadweight (£m)	4,580	7,391	11,970	38%
Discounted lifetime fuel cost savings, after reduction for comfort taking (£m)	4,815	7,872	12,688	38%
Discounted lifetime fuel cost savings after reduction for comfort taking and net of deadweight (£m)	4,063	6,677	10,740	38%
Costs:				
Total cost of installations within scheme (£m)	1,791	2,512	4,302	42%
Total cost of installations to suppliers (£m)	1,519	1,240	2,759	55%
Total cost of installations to householders (£m)	87	1,207	1,294	7%
Total cost of installations to social housing providers (£m)	184	65	249	74%
Cost to suppliers per customer (£)	£144	£79	£105	

Cost to suppliers per bill (£)	£26	£14	£19	
Benefits net of costs:				
Total benefits of whole programme (NPV) (£m)			**7,529.40**	
NPV per tonne of carbon dioxide £/tCO2			**£48.39**	
Householders' lifetime benefit after their costs (per household)	£449	£426	£435	

Note A:
Calculation of the number of households in the Priority Group

The criteria for eligibility of the Priority Group have been changed since EEC2. The group has been expanded to include all households with a member over the age of 70, as well as all those on the benefits described in section 1

Benefits making up Benefits Priority Group (BPG)

According to the Electricity and Gas (Energy Efficiency Obligations) Order 2004, a household is in the priority group if they receive:

(a) council tax benefit;

(b) housing benefit;

(c) income support;

(d) an income-based jobseeker's allowance;

(e) an attendance allowance;

(f) a disability living allowance;

(g) a war disablement pension which includes a mobility supplement or a constant attendance allowance;

(h) a disablement pension which includes a constant attendance allowance;

(i) pension credit; or

(j) child tax credit or working tax credit with an income of no more than £15,592 .

Households with a member over the age of 70, regardless of income, are also included in the priority group. BERR data suggests that this will add an extra 1.7m households to the priority group. In the remainder of this document, the term “Benefits Priority Group (BPG)” shall be used to refer to those households which qualify for the priority group because they are in receipt of benefits or tax credits, and “Priority Group (PG)” shall be used to designate the whole of the priority group, ie including those not on benefits or tax credits, but aged 70 or older.

The Family Resources Survey

The Family Resources Survey (FRS) collects information on the incomes and circumstances of private households in the United Kingdom. It has been running since

October 1992. During the 2004-05 full survey year approximately 26,000 households were interviewed in Great Britain.

In terms of the groups making up the Benefits Priority Group, the survey contains data on receipt of all applicable Priority Group benefits except disablement pension. It also does not collect whether someone in receipt of war disablement pension has a mobility supplement included in that payment. Unlike the main administrative data of the Department for Work and Pensions (DWP), the survey allows household level data to be derived.

Derivation of the numbers of households in the Benefits Priority Group

The way the overall level of Benefits Priority Group households was derived was to start with those benefits received at individual level and then collapse the data set into ultimately a household level data set.

At an individual level, this dataset contains whether someone is in receipt of income support, jobseeker's allowance, attendance allowance, disability living allowance, war disablement pension and pension credit (amongst other benefits). The assumption was made to include all war disablement pension cases, as it was not possible to separate out those that received a mobility component. The effect of this assumption was small. This data was used to derive how many households were in the Benefits Priority Group because they were receiving these benefits, which produced a figure of around 5.5 million Benefits Priority Group households.

At a household level, this dataset contains whether the household is in receipt of council tax or housing benefit. This brings an additional 1.1 million households into the Benefits Priority Group, who received council tax or housing benefit, but not income support, jobseeker's allowance, attendance allowance, disability living allowance, war disablement pension or pension credit.

Finally, at a benefit/family unit level, this dataset contains whether someone in the unit is in receipt of tax credits and the family income. This income was not adjusted to make it fully consistent with the applicable income used to derive the tax credit award, as this is not directly available in the survey and is dependent on individual circumstances. We therefore included all those cases where the family income was no greater than £280 per week. The addition of the tax credit criteria was assessed to bring around a further 0.4 million households into the Benefits Priority Group

Combining households containing any of the above benefits or tax credits gives an overall figure of 7.0 million Benefits Priority Group households.

Why this will be an underestimate

Table 10 compares overall benefit and tax credit receipt at an individual or family unit level for the FRS and DWP administrative data. Administrative data is based on larger samples or even information on all claimants, and covers information such as age and gender of claimant, duration of their spell on benefit and geographical locations of claimants. It is difficult to collapse this data down to household level, and to bring in tax credit and housing and council tax benefit data, which makes it difficult to derive the size of the Priority Group from this source alone.

Table 10: FRS and administrative data compared

Benefit	FRS data	Administrative data	Ratio of FRS to administrative data
Income Support	1,745,902	2,139,000	82%
Pension Credit	1,681,148	2,432,300	69%
Housing Benefit	3,407,021	3,932,800	87%
Council Tax Benefit	4,666,928	4,879,200	96%
Jobseeker's Allowance	561,026	739,800	76%
Attendance Allowance	977,027	1,510,400	65%
Disability Living Allowance (Care Component)	1,628,358	1,922,900	85%
Disability Living Allowance (Mobility Component)	1,681,804	2,134,500	79%
Working Tax Credit – family unit level	1,241,988	1,729,000	72%
Child Tax Credit – family unit level	3,942,431	4,166,000	95%

Source: Table M.6 of the 2004-05 FRS publication.

Addressing the undercount – scaling up the FRS statistics

Given the 7.0 million estimate will be an underestimate, there are various options to derive an estimate of the true Benefits Priority Group size. The first way is to scale up the estimates above based on the undercount data above.

The most straightforward way of approximating this effect is to work out the average percentage undercount on the FRS relative to administrative data, weighted by the

numbers claiming the benefit. This gives an overall undercount of benefits on the FRS of around 84 per cent, so scaling up the Benefits Priority Group by this amount gives an estimated size in 2004-05 of around 8.3 million households.

This is a crude approximation, which does not incorporate any adjustments to reporting rates for household receiving multiple benefits. A possible refinement is therefore to average each of the benefit undercount data when the individual is on multiple benefits. This increases the estimated total to around 8.5 million households. See Table 11.

Table 11: Adjusted and unadjusted FRS data compared

Benefit	Original FRS estimates	Adjustment for undercount
Main DWP benefits	5.5	6.8
Addition of Council Tax and Housing Benefit only recipients	1.1	1.3
Addition of tax credit only recipients	0.4	0.4
Total	7.0	8.5

Addressing the undercount – use of administrative data

An alternative way of addressing the undercount issue is to apply the profile of benefit recipients on the Family Resources Survey to administrative data. This has the advantage of using data that is not subject to the same survey variability. It also allows more timely estimates to be produced.

The Work and Pensions Longitudinal Study is based on DWP's complete claimant database. It estimates that the overall number of individuals in receipt of various combinations of Pension Credit, Income Support, Disability Living Allowance, Attendance Allowance or Jobseeker's Allowance (income-based) in May 2006 is around 7.8 million. The average number of households in receipt of these benefits over the four quarters making up the FRS survey year is 7.6 million. The increase is due to the number of benefit recipients increasing over the period for all benefits except income support. Data is accessible via http://193.115.152.21/100pc/tabtool.html.

According to the FRS, the number of households containing someone in receipt of these benefits is around 90 per cent of the number of individuals receiving these benefits. This implies around 7.0 million households in May 2006 contain someone in receipt of Pension Credit, Income Support, Disability Living Allowance, Attendance Allowance or Jobseeker's Allowance (income-based). The figure for the quarters making up the FRS survey is around 6.8 million.

According to the FRS, around a quarter of households in receipt of council tax benefit were not in receipt of any of the benefits detailed above, and there were very few households who were in receipt of only housing benefit. According to DWP data, around 5.1 million households were in receipt of Council Tax Benefit in May 2006. This means an additional 1.3 million households are in the Benefits Priority Group for that period. In terms of the period corresponding to the FRS survey, the figure was around 4.9 million, implying an additional 1.2 million households in fuel poverty. DWP's Council Tax and

Housing Benefit data is based on a survey of Local Authorities and therefore is not as robust as their other benefit data.[31]

Finally, according to HMRC administrative data[32], in April 2006, around 1.85 million individuals were in receipt of tax credits where the applicable income is less than £15,592, with 1.75 million over the FRS period. The relevant income banding published by HMRC goes from £10,000 to £20,000, and it has been assumed around half of the family units in this band have an applicable income less than £15,592. This is based on a random sample of 10 per cent of single adults (with or without children) and 20 per cent of couples. The FRS gives a much lower figure of households earning less than £15,592 on tax credits, but this might be because of the income definition differences or because of the banding approximation.

According to the FRS, around 55 per cent of tax credit recipients receiving earning less than £15,592 are not in receipt of any other benefits and the number of households containing someone in receipt of these tax credits is around 95 per cent of the number of family units receiving them. This means an additional 0.9 million households are estimated to be in the Priority Group in May 2006, and also an additional 0.9 million in the FRS period. See Table 12.

Table 12: Administrative and scaled FRS data compared

Benefit	Adjusted FRS data	Administrative data (FRS period, Apr 2004 to Mar 2005)	Administrative data (May 2006)
Main DWP benefits	6.8	6.8	7.0
Addition of Council Tax and Housing Benefit only recipients	1.3	1.2	1.3
Addition of tax credit only recipients	0.4	0.9	0.9
Total	8.5	8.9	9.2

Extension of the Priority Group to include the over 70's

[31] See http://www.dwp.gov.uk/asd/hbctb.asp for details.
[32] http://www.hmrc.gov.uk/stats/personal-tax-credits/cwtc-quarterly-stats.htm

Households with a member over the age of 70, regardless of income, are also included in the priority group. BERR data suggests that this will add an extra 1.7m households to the priority group.

The overall size of the priority group is therefore taken as 8.8+1.7=10.5 million households. For the purposes of simplicity, for the remainder of this document, the priority group will be referred to as "PG", and that part of the priority group that is on benefits will be referred to as "BPG".

Note B:
Remaining potential for cavity wall insulation

Number of cavities uninsulated based on EHCS 2004, SCHS, WCHS data

Before 1983 the majority of dwellings were built without cavity wall insulation.

Subsequent changes to the wall U-value in the Building Regulations Part L were as follows:

- from 1983: U-value 0.6 W/m^{2}K (formerly 1.0)
- from 1991: U-value 0.45, W/m^{2}K but 0.6 W/m^{2}K if double glazed
- from 1996 to 2002: U-value 0.45 W/m^{2}K, or other value if 'Target U-value method' used, (e.g. 0.6 W/m^{2}K if a condensing boiler was installed).

From 2003 the U-value improved again to 0.35 W/m^{2}K and the majority of dwellings were built with insulated cavity walls.

A survey of England and Wales building control applications in 1998 indicated that a significant proportion of walls were still being built without insulation[33].

A 'consensus estimate' from within BRE suggested:

- 90% unfilled when built in 1983 to 1990
- 50% unfilled when built in 1991 to 2002
- very few unfilled when built from 2003.

EHCS 2004 data recorded, for cavity walls believed to be unfilled at date of survey.

[33] BRE report for DETR/BR 1998. Review of the operation of the 1995 Edition of the Regulations for the Conservation of Fuel and Power (England and Wales)

- 950,000 or 52% of cavity walls unfilled (in 2004) for 1981-1990 dwellings
- 800,000 or 34% of cavity walls unfilled (in 2004) in post 1990 dwellings.

This implies a decrease in % of unfilled walls from date built to 2004, from 90% to 52% for 1980s dwellings, and 50% to 34% for 1990s dwellings. One would expect such a decrease due to installation of retrofit insulation in a proportion of the walls.

These numbers compare with an EHCS 2004 total for dwellings of all ages, of 9.217 million cavity walls unfilled (in 2004).

There are uncertainties in the EHCS 2004 data for dwellings built between 1983 and 2002, because of the difficulty of identifying, in 2004, whether the cavity wall contains insulation that was installed when built. In addition there is no indication whether these would be over or underestimated. Retrofit insulation installed at a later date can be identified more easily from the drill holes.

However, overall the above gives consistent data for the transitional period between most dwellings built without cavity wall insulation and most dwellings built with insulation.

The EHCS 2004 data of 9.217 million total cavity walls unfilled (in 2004) is therefore used for England. Similar data is used from the WHCS 2004, and from the SHCS 2002 with some adjustment to update it to 2004. See Table 13.

Table 13: Cavity wall data 2004

	England	**Scotland**	**Wales**	**GB**
(source)	*EHCS 2004*	*SHCS 2002*	*WHCS 2004*	
Households	21.613m	2.192m	1.209m	25.014m
Houses with cavity walls	15.042m	1.582m	0.786m	17.410m
% Houses with cavity walls	70%	72%	65%	
Cavities uninsulated	9.217m	1.238m[1]	0.456m	10.911m
% Cavities uninsulated	61%	78%	58%	

[1]corrected to 2004 value

Taking account of unfillable cavity walls

The above number of uninsulated cavity wall dwellings is then reduced to allow for situations where they should not be filled, such as the following:

- Height of wall greater than 12 meters. (The number of high rise dwellings, four or more storeys, with uninsulated cavities is indicated by EHCS 2004 data as 330,000.) Note however, that subsequent information from CIGA indicates that, subject to survey, cavity wall insulation can be, and is often installed in buildings up to 45m tall, . We therefore anticipate that the figure of 330,000 is an over-estimate of the unfillable cavities.
- Construction appropriate to locality, including its exposure (insulation is acceptable if the outer leaf construction is in accordance with the requirements for local exposure conditions)
- Cavity width less than 50mm (40mm for UF foam)
- Walls below ground level (unless certain that water is drained from cavity)
- Finlock gutters, unless they have been lined
- Water penetration or rising damp is evident.

Cavity walls in dwellings of timber frame, steel frame, concrete construction, system built, or natural stone, should also not be retrofit insulated, but these are excluded from 'cavity walls unfilled' in EHCS. Areas of tile hanging, timber boarding, recessed panels should also not be retrofit insulated, but these are normally a small proportion of the wall area and do not affect the above numbers.

An estimate that 5% of households with cavity walls are 'unfillable' has been applied. Note that this must be 5% of the historical original number of 'uninsulated when built' cavity walls. (Both of these are essentially fixed numbers since 2003, when the majority of cavity walls started to be insulated when built.)

The historical number of uninsulated cavity wall households is obtained as follows.

- the number of dwellings built annually from 1983 to 2003
- estimating that 90% of these are cavity walls
- using the estimates above for the percentage built with cavity wall insulation during these years

This gives 1.261 million dwellings built with insulated cavity walls

Subtracting this from the 2004 figure of 17.410 million cavity wall GB dwellings gives

16.149 million households as the historical number of uninsulated cavity walls, so 5% of this is an estimated 'unfillable' 807,000 households.

This reduces the 10.911 million GB households with uninsulated cavity walls
to

10.103 million GB households with 'fillable' cavity walls in 2004.

Benefits Priority Group (BPG) and 2004-8 installations

Analysis of EHCS data combined with benefit receipt data for England, Wales and Scotland from DWP's Family Resources Survey indicates that about 28.5% of households in Great Britain with uninsulated cavity walls are in the Benefits Priority Group. Of the 10.103 million households, this gives

- 2.878 million dwellings in the **Benefits** Priority Group,
- 7.225 million dwellings in the **non Benefits** Priority Group.

However, recent information from BRE suggests that the EHCS tends to under-estimate the number of filled cavities by around 5-10%. To be conservative, Defra has taken the figure of 10%. The revised estimate of BPG and non-BPG fillable cavities in 2004 is therefore:

- 2.590 million dwellings in the Benefits Priority Group,
- 6.503 million dwellings in the non Priority Group.

Estimates of insulation installed from 2004 to 2008 as a result of EEC and Warm Front are then subtracted, as follows (Table 14):

Table 14:Calculation of the Number of Fillable Cavities, 2008

	Benefits Priority Group	**Non Priority Group**
Households with 'fillable' cavity walls GB 2004	**2.590m**	**6.503m**
EEC 2004-05	0.200m	0.150m
EEC 2005-08	0.650m	0.625m
Warm Front 03/04 + 04/05 + 05/06	0.100m	0
Warm Front 06/07 + 07/08	0.066m	0
Other fuel poverty programmes 03-08	0.033m	0
Remaining 'fillable' cavity wall households 2008	**1.541m**	**5.728m**

Effect of churn

There is a constant movement of households into and out of the Priority Group, as individuals move in and out of eligibility for the relevant benefits. Due to the larger

proportion of households with 'fillable' cavity walls in the non Priority Group, this movement provides an overall net gain to the Priority Group of households with 'fillable' cavity walls.

EHCS 2004 data indicates:

- 8.8 million households in the Benefits Priority Group, so from table 14, above, 17.5% of the homes have 'fillable' cavities
- 15.7 million households in the non Priority Group, so from table 14, 32.9% have 'fillable' cavities.

Standard estimates, for benefits churn alone, are 20% over the period 2005-2008. However, in order to be conservative, we have taken a lower figure of 10%. This gives the number of households moving between BPG and non-BPG as 0.88 million. Thus around 154,000 households with 'fillable' cavity walls move from the BPG to non BPG, and around 290,000 move from non BPG to BPG. This is a net movement of 136,000 of households with fillable cavity walls, moving from non BPG to BPG. See Table 15.

One may also consider the effect of individuals in owner occupied households with 'fillable' cavity walls who refuse to have insulation installed. During the three years of CERT some of these will move, thus removing this barrier. However, these figures are very low, and quite uncertain, and so have been omitted.

Table 15:Reduced Estimate of Churn

	BPG	non BPG
'Fillable' cavity wall households 2008	1.541m	5.728m
Low estimate of churn from movement of benefits (10%)	0.136m	-0.136m
With effect of churn	1.677m	5.592m

In CERT, the Priority Group has been expanded to include all over 70's, regardless of income. Based on the EHCS, BERR has estimated that this would result in 700,000 additional fillable cavities being transferred from the non-PG to the PG (2008 values). The revised split of fillable cavities in the PG and non-PG in 2004 is therefore:

- 2.377 million dwellings in the Priority Group,
- 4.892 million dwellings in the non Priority Group.

It is difficult to obtain reliable estimates for the number of householders who will refuse to install cavity wall insulation. Table 16, shows the proposed levels of cavity insulation in the current version of the illustrative mix as a proportion of the number of technically fillable cavities in the PG and non-PG respectively.

Table 16: Percentage of fillable cavities to be filled during CERT

	PG	non PG
'Fillable' cavity wall households 2008 (taking into account 10% churn)	2.377m	4.892m
Suggested numbers of cavity wall insulations in the illustrative mix	1.225m	1.725m
Percentage of fillable cavities filled if the number of installations is as in the illustrative mix	52%	35%

Note C:

Microgeneration & Community Heating Measures

General Points

Measures included

Following the consultation, and in partnership with BRE & Ofgem, Defra has now produced firm scores for most microgeneration measures. These measures are:

- Biomass boilers for individual dwellings
- Wood log stoves
- Wood pellet stoves
- Ground source heat pumps
- Solar thermal (flat plate & evacuate tube type)
- Solar PV
- Roof-mounted micro-wind
- Pole-mounted mini-wind
- Micro-CHP (Stirling engine)
- Micro-hydro

For some forms of microgeneration, there is still insufficient evidence to set a fixed score. If these measures are installed, it should be via the demonstration route. These measures are:

- Air source heat pumps
- Fuel cells

Community heating systems are also eligible for CERT support. Three kinds of community heating systems have been included in the illustrative mix. These are:

- Community biomass heating
- Community biomass CHP
- Community ground source heat pumps.

It is assumed that most of the community heating measures will be installed in blocks of flats.

Energy, fuel cost & carbon dioxide savings for heating measures

It is very important to note that the carbon dioxide savings for heating measures are highly dependent on the heating system being displaced. For example, carbon dioxide savings are higher if the heating system displaced is electric, rather than gas. For the illustrative mix, Defra has taken weighted averages, based on estimates of which heating systems are likely to be displaced by the new measures.

New build

Microgeneration and community heating measures in new build properties are eligible for CERT, provided that the amount installed goes beyond the requirements of the Building Regulations or any local planning rules (for example, the Merton Rule).

In some cases, particularly solar thermal, PV and ground source heat pumps, the installation costs may be substantially lower for new build properties than in the retro-fit sector. For electricity generating measures, the carbon dioxide savings in the new build sector will be the same as in the retrofit sector. For heating measures, this may not be the case; for example, if a solar thermal panel is installed in a new build gas centrally heated property, the carbon dioxide savings will be approximately 10% lower than if it is installed in a gas centrally heated property with a boiler whose efficiency is typical of the stock average.

In the illustrative mix, it has been assumed that all solar thermal, individual biomass boilers, wood stoves and individual ground source heat pumps will be installed in the retro-fit sector. The costs and carbon dioxide savings are appropriate to this sector. Similarly, it has been assumed that all community biomass heating and community biomass CHP would be installed in existing buildings, probably blocks of flats. However, it has been assumed that community ground heat pumps would be installed in new build only and costs and carbon savings given in the illustrative mix reflect this.

Description of measures

Biomass boilers for individual dwellings

For the illustrative mix we assume that 100% of the space and water heating energy are provided by a boiler burning wood pellets, at a seasonal gross efficiency of 80% (which equates to a seasonal net efficiency of 80%). The responsiveness is estimated as 0.75. It should be noted that this implies changing fuel and therefore the energy savings are the difference of the energy content of two different fuels. After consultation with the

Renewable Energy Association, we have assumed that wood pellet boilers would be installed in the following types of home:

- Gas central heating (20%)
- Oil central heating (40%)
- Solid fuel central heating (40%).

It should be noted that these assumptions only apply to the illustrative mix; in reality, suppliers may subsidise installations of biomass boilers in electrically heated homes, which would result in higher carbon dioxide savings

Wood pellet burning stoves

The assumption used for the savings for wood pellet burning stoves is that 10% of space heating would be obtained from wood (burned at a seasonal gross efficiency of 70%) instead of the main heating fuel. It is assumed that wood stoves are installed in homes without gas or oil based heating systems.

Log burning stoves

The assumption used for the savings for wood log burning stoves is that 10% of space heating would be obtained from wood (burned at a seasonal gross efficiency of 65%) instead of the main heating fuel. It is assumed that wood stoves are installed in homes without gas or oil based heating systems.

Photovoltaic panels (PV)

A 2.5 kWp PV system is assumed. The annual electrical output is estimated by applying a factor 846 kWh/yr per kWp, implying an annual output of 2115 kWh/yr. Both the size and conversion factor are based on a recent EST Element Energy microgeneration report[34].

Solar water heating

For solar water heating, it is assumed that a typical flat plate unit with a collector area of 4m² would be fitted and that its efficiency (in the form used in BREDEM) is 58%. These inputs result in the calculated provision of 33% of annual hot water needs for the dwelling modelled.

The carbon dioxide saving score for the evacuated tube of solar water panels is slightly higher than that for flat plate solar thermal panels. The evacuated tube panels are more

[34] "The Potential for Microgeneration, Study and Analysis", Element Energy, November 2005

expensive than the flat plate ones, and so have not been included in the mix, although they are eligible for CERT, and would receive a slightly higher score.

Note that the calculations of energy, cost & carbon dioxide savings for solar thermal have been based on retro-fit systems. If solar thermal panels were installed in new build properties with gas condensing boilers, the costs would be lower, but the carbon dioxide savings would be reduced by around 10%.

Roof-mounted micro wind turbines

The assumed installed capacity of a rooftop micro-turbine is 1 kWp. An average load factor of 10% is assumed for the 8766 hours in a year[35], leading to a figure for annual electricity generation of 0.877 MWh/yr. The load factor (LF) is highly dependent on the mean windspeed, turbulence and also on the distribution of wind speeds. It is expected that, depending on location, the load factor could vary between 5% and 30%. The value chosen here corresponds to a mean wind speed of 4.7 m/s, and Weibull parameters A and k of 5.3 m/s and 2 respectively. This is a little higher than the average wind speed in a built up area, but it has been assumed that most micro-wind turbines will be installed in areas which are windier than the average.

The lifetime of micro wind turbines is assumed to be 10 years, which is consistent with estimates by manufacturers such as WindSave.

(Note that compared to the first draft of the illustrative mix, the assumed wind turbine has been changed from 1.5 kWp to 1.0 kWp, and the load factor reduced from 17% to 10%.)

Pole-mounted mini wind turbines

Pole-mounted wind turbines are considered separately from the roof-mounted type. The average installed capacity assumed in the illustrative mix is 5 kWp, and the capacity factor has been assumed to be 20%, which corresponds to a mean wind speed of around 5 m/s. The annual electricity production is therefore assumed to be 8.766 MWh/yr. The lifetime has been taken as 22.5 years, which is the average value of the figures given by Iskrawind (20 years) and Proven (25 years).

Micro hydro

It is assumed that a micro hydro turbine of 0.7 kWp is installed and that it has an annual average load factor of 50%, leading to an annual output of 3068 kWh/yr. Size, load factors and lifetime are based on the EST Element Energy microgeneration report.

[35] 8760 hours per normal year, and 8784 hours per leap year.

Individual dwelling ground source heat pumps

We are assuming ground source heat pumps where the space heating is provided using electricity at a seasonal efficiency of 320% (with responsiveness of 1) and water heating would be achieved at an efficiency of 150%. The seasonal efficiency is taken from SAP 2005; note that it must not be confused with the coefficient of performance (which is higher, and which is the value generally quoted by the industry). Defra commissioned BRE to carry out a desk study to examine HPA & GSHPA data on heat pumps. The study concluded that there is insufficient evidence to update the SAP values at present.

For the purposes of the illustrative mix, it has been assumed that ground source heat pumps for individual dwellings would replace the following heating systems:

- Gas central heating (20%)
- Oil central heating (40%)
- Solid fuel central heating (40%).

Note that the assumptions are different for community ground source heat pumps.

Air source heat pumps

Although air source heat pumps are widely used in the commercial and business sectors, they are relatively new in the household sector, where the performance sector may be different to that in the commercial sector. Defra & Ofgem have not received sufficiently detailed data to enable a reliable score to be set. Air source heat pumps have therefore not been included in the illustrative mix, but would be eligible as a demonstration measure.

Micro-CHP

The carbon dioxide saving score for Stirling Engine micro-CHP is based on the interim report of the Carbon Trust Micro-CHP field trials[36].

Domestic fuel cells

These measures are not included in the illustrative mix, although they would be eligible for CERT as demonstration measures.

[36] "Micro-CHP Accelerator, Interim Report", Published by the Carbon Trust, November 2007

Community biomass heating

Community biomass heating schemes are eligible for CERT support. Existing schemes for blocks of flats, such as those in Sheffield and Barnsley, have attracted local authority funding. Community biomass heating would tend to use wood chip, rather than the more expensive wood pellets.

In the illustrative mix, we have assumed an average installed capacity of 100 kWth. The seasonal efficiency has been taken as 75% gross (86% net) and the responsiveness of the community heating system as 1. The distribution factor has been taken as 1.1 (which means that to supply 100 units of useful heat, 110 units must enter the heating distribution system). This is within the SAP 2005 range of 1.05 and 1.2. Further details are given in BRE's memo[37].

For the purposes of the illustrative mix, it has been assumed that community biomass would replace the following heating systems:

- Gas central heating (20%)
- Oil central heating (40%)
- Solid fuel central heating (40%).

Community biomass CHP

It has been assumed that 30% of total heat requirement is met by the CHP unit and that 70% is met by normal (biomass) boilers. The CHP unit produces twice as much heat as power. So in producing 30% of the heat, the unit produces 15% of the total heat demand in electricity.

The seasonal gross heating efficiency is 75% for the boilers and 2/3*80% = 53.3% for the CHP unit. The average heating efficiency is therefore 30%*53.5%+75%*70% = 68.5%.

The distribution factor has been taken as 1.1 (see comments for community biomass heating, above).

Community ground source heat pumps

The calculations are based on a 90 kW heat pump serving 20 flats. The same seasonal efficiencies are assumed as for ground source heat pumps for individual dwellings.

[37] BRE memo on community biomass heating, EEC3_PAD_07_117.

The distribution factor has been taken as 1.1 (see comments for community biomass heating, above).

For the purposes of the illustrative mix, it has been assumed that community biomass would replace the following heating systems:

- Gas central heating (90%)
- Oil central heating (10%)

Note that it has been assumed that community ground source heat pumps would be installed only in new build homes, where the default heating system would be a gas condensing boiler. This accounts for the relatively low carbon dioxide savings from this measure. If community gshp were installed in homes off the gas grid, the carbon dioxide savings would be substantially higher and this would become a more cost effective measure for suppliers.

Costs assumed for Microgeneration Measures

Costs of microgeneration and therefore possible numbers of installations under CERT are difficult to ascertain, because the industry is immature. It would seem reasonable to assume that costs shall drop as the industry becomes more established; however, in the interests of caution, no attempt has been made to model the possible decrease in prices. (See Table 17).

Table 17: Assumed Costs of Microgeneration Measures

Type of measure	Capacity	Cost	Marginal cost	Comments
Pellet burning stoves (secondary)	4-5kW	£1,500	£1,417	4-5kW capacity
Log burning stoves	4-5 kW		£1,000	
Biomass boilers (primary)	15kW	£9,000	£7,200	Average weighted marginal cost. Source: EST £5,000-11,000 including fitting flue.
PV (2.5 kWp)	2.5 kWp	£6,000		This is the new build cost for new developments rather than a single house. The retro-fit cost is higher (£9,375). We

Type of measure	Capacity	Cost	Marginal cost	Comments
				anticipate that most PV going through CERT will be in the new build market. Source Sharp PV.
Solar Water Heating	$4m^2$	£3,500 retrofit £2,000 new build		Flat plate solar water heaters. The new build figures refer to new developments, rather than a single new house. Unlike PV, carbon dioxide savings from solar thermal will be lower in a new build house on the gas grid than in the retrofit sector. The carbon dioxide saving figures in the mix refer to the average of the existing stock. Therefore, the cost in the mix refers to the retrofit market, not the new build market. Source STA.
Micro-wind	1kW	£3,200		Source : Ampair
Mini-wind	5 kWp	£21,000		Source : Iskra wind
Micro-hydro	0.7kW	£1,890		Assumes weir or pond already in place. Low head. Source: EST
Ground source heat pumps for individual dwellings	12kW	£13,200	£11,360	Costs are for horizontal pipes; vertical drilling would increase costs. Estimated costs for an 8 kW gshp are £11,000. Source: GSHPA.
Community biomass heating	500kWth	£76,000	£61,000	Supplies 175 dwellings. Cost depends on installed capacity: 100 kW £18,500 220 kW £36,000 500 kW £76,000 750 kW £102,000 1 MW £120,000 Source : REA.
Community biomass CHP	500 MWe/2 MWth	£1.5m	£1.48m	Supplies 160 dwellings, so £9,281 per dwelling

Type of measure	Capacity	Cost	Marginal cost	Comments
				Source: REA
Community ground source heat pumps	90 kW	£100,000	£85,000	Would service 20 flats. Source: GSHPA

It is important to note that new build costs for microgeneration may be substantially lower than retro-fit costs. For heating measures, the energy savings are also lower for new-build than for retro-fit, but for electricity generating measures, the savings are the same.

For this reason, the costs for electricity generating microgeneration are new-build costs, rather than retrofit. This has little effect for micro-wind or mini-wind, but accounts for a substantial reduction for PV.

For heat generating microgeneration, (eg solar thermal & individual dwelling ground source heat pumps), the retro-fit costs and savings have been used. Since solar thermal is estimated to be installed primarily in gas heated homes, the savings would reduce by around 10% if they were installed in new-build homes. However, data from the STA indicates that new-build costs could be substantially lower than retro-fit costs (around £2,000 as opposed to £3,500), which would make this measure more attractive to suppliers.

Proportion of costs met by suppliers

It has been assumed that suppliers would contribute around 20% of the capital cost of each microgeneration measure in the non-Priority Group. Given the relatively high costs of microgeneration, it has been assumed that microgeneration measures are either delivered in the non-priority group, or for the PG in the social sector with financial contributions of 50% by local authorities / social landlords.

Relative cost effectiveness of each measure to suppliers

The table below shows the relative cost-effectiveness of each measure installed to the supplier. It is assumed that the proportion of costs met by the suppliers is as given in Table 7. Microgeneration and community heating measures are shown in bold. Note that the ranking of cost effectiveness is different in the priority and non-priority groups.

Table 18: Cost Effectiveness Ranking of Different Measures in the Priority and non-Priority Groups (Microgeneration & Community Heating Measures in Bold)

Rank in PG	Measure	Rank in non-PG	Measure
1	**Community heating with wood chip**	**1**	**Community heating with wood chip**
2	Loft insulation (DIY)	2	Loft insulation (DIY)
3	Appliances - iDTVs	3	Appliances – iDTVs
4	CFLs - retail	4	Tank insulation - top-up
5	Tank insulation - top-up	5	CFLs – retail
6	Cavity wall insulation	6	Cavity wall insulation
7	Fuel Switching	7	Fuel Switching
8	Loft insulation (professional)	**8**	**Micro Hydro (0.7kWp, 50% LF)**
9	CFLs - direct	9	Loft insulation (professional)
10	A/B rated boilers (exceptions)	**10**	**Ground source heat pumps**
11	SWI internal	**11**	**Wood pellet boilers (primary)**
12	**Ground source heat pumps**	12	Heating controls – extra
13	Heating controls - extra	13	SWI internal
14	**Wood chip CHP**	14	CFLs – direct
15	Draughtproofing	**15**	**Log burning stoves**
16	PC mains panels	16	Wood pellet stoves (secondary)
17	Appliances - Cold	17	Efficient halogens
18	**Wood pellet boilers (primary)**	18	Insulated wallpaper
19	Micro Hydro (0.7kWp, 50% LF)	19	SWI external
20	SWI external	20	Draughtproofing
21	Insulated wallpaper	21	Appliances – Cold
22	Efficient halogens	22	A/B rated boilers (exceptions)
23	**Log burning stoves**	**23**	**Wood chip CHP**
24	Glazing E to C rated	24	PC mains panels
25	**Mini-wind 5 kW, 20% LF**	**25**	**Mini-wind 5 kW, 20% LF**

Rank in PG	Measure	Rank in non-PG	Measure
26	**Wood pellet stoves (secondary)**	**26**	**Photovoltaic panels (2.5 kWp)**
27	**mCHP**	27	Glazing E to C rated
28	Heating controls - upgrade with boiler	28	Heating controls - upgrade with boiler
29	**Photovoltaic panels (2.5 kWp)**	**29**	**mCHP**
30	Appliances - Wet	**30**	**Solar Water Heater (4m²)**
31	LNBs	31	LNBs
32	Energy saving kettles	**32**	**Micro Wind (1 kWp, 10% LF)**
33	**Solar Water Heater (4m²)**	33	Appliances – Wet
34	**Micro Wind (1 kWp, 10% LF)**	34	Energy saving kettles
35	**Community GSHP**	**35**	**Community GSHP**

Note that community gshp appears not to be cost effective because it has been assumed that it would be installed in new build only, therefore mostly replacing gas central heating. If it were installed in an area which is off the gas grid, carbon dioxide savings would be higher, and the relative cost effectiveness would increase. It should be noted that the ranking order is highly dependent on the assumed levels of CERT subsidy.

Number of Microgeneration & Community Heating Installations in the Illustrative Mix

The figures for the different measures are believed to be low compared to the capacities of the different industries to deliver. The principal industries are:

- Ground source heat pumps
- Community biomass heating
- Community biomass CHP
- Solar thermal

The GSHPA and HPA have confirmed that the figures of ground source heat pumps given in the mix (13,000 individual dwellings and 1,000 flats) are easily achievable over the CERT period.

The REA supplied estimates of the possible number of community biomass CHP and biomass community heating systems that could be installed during the period 2008-2011.

In order to be conservative, Defra has taken data for the first year only (for biomass CHP), and for the first two years only (for biomass community heating).

In 2005, the STA estimated that total around 120,000 solar thermal installations would take place during the period 2008-2011. The market expanded more than anticipated in 2006, and therefore, the numbers of solar thermal panels shown in the mix are considered to be easily achievable.

Table 19: Number of microgeneration and community heating installations in the illustrative mix

Measures	Priority Group	Non-priority group	Total	Comments
Community biomass CHP	1,000	400	1,400	Flats
Community ground source heat pumps	500	500	1,000	Flats
Community heating with wood chip	11,200	5,200	16,400	Flats
Wood pellet stoves (secondary)	0	250	250	
Log burning stoves	0	250	250	
Wood pellet boilers (primary)	0	3,000	3,000	
Solar Water Heater (4m²)	20,000	50,000	70,000	
Ground source heat pumps	0	13,000	13,000	
Micro Wind (1 kWp, 10% LF)	0	100	100	
Mini-wind 5 kW, 20% LF	0	250	250	
Micro Hydro (0.7kWp, 50% LF)	0	50	50	
Photovoltaic panels (2.5 kWp)	0	300	300	
mCHP	200	200	400	

Results

Table 20: Summary results for Microgeneration & Community Heating Measures

	PG	non-	Total

		PG	
No of community heating installations	12,700	6,100	18,800
No of microgeneration installations	20,200	67,400	87,600
Capital cost of community heating installations £m	16.51	8.25	24.76
Capital cost of microgeneration installations £m	75.27	374.96	450.23
Capital cost of community heating systems to householders £m	0.00	1.51	1.51
Capital cost of community heating systems to social housing £m	18.82	6.17	24.99
Supplier costs for community heating installations £m	9.46	4.37	13.84
Supplier costs for microgeneration installations £m	56.45	90.83	147.28
Total CERT costs to suppliers £m			2,759
Proportion of suppliers' costs spent on community heating			0.50%
Proportion of suppliers' costs spent on microgeneration			5.34%
Lifetime carbon dioxide savings from community heating MtCO2	1.29	0.66	1.95
Lifetime carbon dioxide savings from microgeneration $MtCO_2$	0.16	2.61	2.77
Percentage of lifetime carbon dioxide savings from community heating			1.27%
Percentage of lifetime carbon dioxide savings from microgeneration			1.80%

Note D:

Translation factors : Demonstration and Flexibility Options

Demonstration Option

The translation factor for the demonstration option is based on the average cost to suppliers to save a tonne of carbon dioxide. Based on the Illustrative Mix, this cost is £18/tCO_2.

Flexibility Option

The flexibility option allows suppliers to reduce their PG target by up to 5 percentage points (ie up to 5% of the **whole** target, **not** 5% of the PG target), provided that the funds saved are spent on fuel poverty measures.

Based on the illustrative mix, the average cost to suppliers to save a tonne of CO_2 in the Priority Group is estimated as £24.70.

The eligible measures for the flexibility option are:

- Internal solid wall insulation to U<=0.5W/m^2K
- External solid wall insulation to U<=0.5W/m^2K
- Ground source heat pumps (in off the gas grid homes only).

Note that, since the flexibility measures are directed towards fuel poor households in the private sector, suppliers would have to pay the entire costs of the measures. Note also that carbon dioxide savings in properties off the gas grid are higher than those in properties on the gas grid.

The procedure for calculating the uplifts for flexibility measures is as follows:

1. Calculate the average carbon dioxide saving of each of the measures above, bearing in mind that the carbon dioxide savings depend on the heating system being displaced. For solid wall insulation, the average savings are the same as in the illustrative mix (ie the figures for different heating systems have been weighted by the proportion of those different heating systems in the GB housing stock). For ground source heat pumps, the weighting used for the flexibility option is shown below.

Table 21: Estimated distribution of heating systems replaced by ground source heat pumps installed as PG flex measures

Measure	**Heating system replaced**						
	Gas CH	**Electric storage heating**	**Oil CH**	**Solid fuel CH**	**Gas non-CH**	**Electric non-CH**	**Solid fuel non-CH**
Ground source heat pumps 12 kW	0.0%	40.0%	0.0%	10.0%	0.0%	40.0%	10.0%

2. Calculate the average cost of each of the measures above, bearing in mind that costs for ground source heat pumps depend on the heating system being replaced – eg if there is no central heating, then central heating needs to be installed, which is an additional cost.

3. Calculate the amount of money that could be spent on flexibility option measures if all the suppliers were to use the flex option to its full extent, ie 5% of the total carbon dioxide saving target.

4. Calculate the numbers of each flexibility measure that could be installed with these funds.

5. Calculate the carbon dioxide saving that would have been obtained, had this money been spent on "ordinary" PG measures.

6. Compare the carbon dioxide actually saved by the measure with the nominal carbon dioxide saving (calculated above).

7. Calculate an uplift from this. Note that this is an uplift, **NOT** an uplift factor. For example, an uplift of 50% means that the score is increased by 50% (or by a factor of 150%). An uplift of 100% means that the score is increased by 100% (or by a factor of 200%).

Results:

Table 22: Estimated weighted average cost and carbon dioxide savings of PG flex measures

	Weighted average cost to suppliers when installed in PG flex	Weighted lifetime carbon dioxide savings when

	homes	installed in PG flex homes tCO_2
Internal solid wall insulation	£3,000	97.10
External solid wall insulation	£4,500	102.49
Ground source heat pump	£13,000	152.92

Table 23: Calculated uplifts for PG flex measures

Measure	Flexibility funds available if all suppliers use 5% flexibility	Number of fuel poverty measures installed	Translation factor tCO2/flex measure	Lifetime tCO2 actually saved by the measure tCO2	Rounded equivalent uplift
Solid wall insulation (internal)	£190m	63,261	121.71	62.69	**95%**
Solid wall insulation (external)	£190m	42,174	182.57	66.30	**175%**
Ground source heat pump	£190m	14,599	527.42	152.92	**245%**

The figures in the final column have been rounded to the nearest 5%.

Glossary

3-bed semi	3-bedroom semi-detached house
BPG	Benefits Priority Group – households eligible for the Priority Group because they are in receipt of benefits, rather than because of the age criterion.
BRE	Building Research Establishment
BREDEM	Building Research Establishment Domestic Energy Model
CERT	Carbon Emission Reduction Target, also known as EEC3
CFL	Compact Fluorescent Light
CHP	Combined Heat and Power
CWI	Cavity Wall Insulation
DIY	Do-it-yourself
DTI	Department for Trade and Industry
DWP	Department for Work and Pensions
EEC1	Energy Efficiency Commitment 2002-05
EEC2	Energy Efficiency Commitment 2005-08
EEC3	Energy Efficiency Commitment 2008-11, also known as CERT
EHCS	English House Condition Survey
ESD	Energy for Sustainable Development Limited
EST	Energy Saving Trust
FRS	Family Resources Survey
GSHP	Ground Source Heat Pump
HMRC	Her Majesty's Revenue and Customs
iDTV	integrated Digital Television
kgC	kilogramme of carbon
kW	kilo watt
kWh	kilo watt hours
kWp	kilo watt peak
LF	Load Factor
LI	Loft Insulation
m-CHP	micro-CHP
m-Hydro	micro-Hydro
m-Wind	micro-Wind
$MtCO_2$	Million tonnes of carbon dioxide
MW	Mega watt
MWh	Mega watt hours = 1000 kWh
non-PG, NP, Others	non-Priority Group
Ofgem	Office for gas and electricity markets
p.a.	per annum
PG	Priority Group
prof	professional
PV	Photovoltaic panels
SWH	Solar Water Heating
SHCS	Scottish House Condition Survey

tCO_2	tonne of carbon dioxide
VAT	Value added tax
WHCS	Welsh House Condition Survey
yr	year