| Title: | Impact Assessment (IA) |
|---|---|
| **Final Stage Impact Assessment for the Green Deal and Energy Company Obligation** | **Date:** 11/06/2012 |
| **IA No: DECC0072** | **Stage:** Final |
| | **Source of intervention:** Domestic |
| **Lead department or agency: DECC** | **Type of measure:** Secondary legislation |
| **Other departments or agencies:** | **Contact for enquiries:** Chris Nicholls 0300 068 6017 |

## Summary: Intervention and Options

**RPC:** AMBER

| Cost of Preferred Option | | | | |
|---|---|---|---|---|
| **Total Net Present Value** | **Business Net Present Value** | **Net cost to business per year** (EANCB in 2009 prices) | **In scope of One-In, One-Out?** | **Measure qualifies as** |
| £8.3bn | -£11.0bn | £1.3bn | Yes | IN |

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

Improvements to the UK's energy efficiency will reduce Greenhouse Gas emissions, improve energy security, mitigate fuel poverty, increase productivity and reduce the costs of meeting the UK's renewable energy target. Government intervention is justified to address market failures and barriers slowing take-up of socially cost-effective energy efficiency measures. These include access to capital and discount rates, information asymmetry, positive innovation externalities, inertia, and incentive incompatibility. Intervention is also justified to help achieve the Government's distributional objectives.

**What are the policy objectives and the intended effects?**

The Green Deal and the Energy Company Obligation (ECO)are complementary policy mechanisms which will address market failures and barriers and hence drive demand for cost-effective energy efficiency measures. The Green Deal aims to overcome access to capital, mismatched incentive problems and provide a trustworthy framework of advice, assurance and accreditation for the energy efficiency supply chain. The ECO aims to provide additional support to deliver measures that are part of a cost-effective strategy for achieving the UK's carbon targets but which will not be fully financeable through the Green Deal, and provides subsidised measures to low income and vulnerable households to relieve fuel poverty.

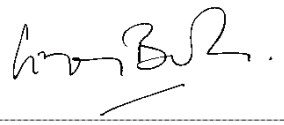
**What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)**

The options considered were: continuing with the existing carbon emissions reduction targets (CERT); adopting the Green Deal with and without ECO targets (set at different levels, which would require different estimated levels of spend to deliver) accompanied by regulating the private rental sector's energy efficiency; or having no policies in place that encourage uptake of energy efficiency in the built environment. The preferred option is the Green Deal accompanied by ECO targets for suppliers, and regulations in the private rental sector. The reason is to encourage the uptake of more costly energy efficiency measures with longer payback rates than those currently delivered under CERT, in order to meet the country's future carbon budgets. The combination of these policies enables a more market-focussed approach to delivering these measures, where competition amongst Green Deal providers is likely to drive take-up beyond the levels expected under CERT or the option of no policies.

**Will the policy be reviewed?** It will be reviewed. **If applicable, set review date:** 10 / 2015

| | | | | | |
|---|---|---|---|---|---|
| Does implementation go beyond minimum EU requirements? | | | **N/A** | | |
| Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base. | **Micro Yes** | **< 20 Yes** | **Small Yes** | **Medium Yes** | **Large Yes** |
| What is the $CO_2$ equivalent change in greenhouse gas emissions? (Million tonnes $CO_2$ equivalent) | | | **Traded: -44** | **Non-traded: -84** | |

***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: 08/06/2012

# Summary: Analysis & Evidence Preferred Policy Option

**Description: Chosen option**

| Price base year 2011 | PV Base Year 2012 | **Time Period 10 years** | **Net Benefit (Present Value (PV)) (£m)** | | |
|---|---|---|---|---|---|
| | | | **Low: £6.3bn** | **High: £9.0bn** | **Best Estimate: £8.3bn** |

| **COSTS (£m)** | **Total Transition** (Constant Price) Yea | **Average Annual** (excl. Transition) (Constant | **Total Cost** (Present Value) |
|---|---|---|---|
| **Low** | Optional | Optional | **£14.9bn** |
| **High** | Optional | Optional | **£18.8bn** |
| **Best Estimate** | | | **£17.3bn** |

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

The majority of the costs of the Green Deal will be borne by the beneficiaries of the energy efficiency measures (some or all of the costs of installing and financing energy efficiency measures and the costs of the Green Deal framework of advice, assurance and accreditation). These costs are estimated at £14.9bn to £18.8bn. The cost of meeting the ECO, administrating the scheme and running the billing system will fall on energy companies, who are expected to pass on these costs to energy consumers.

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

The installation of energy efficiency measures may have adverse impacts on householder health in a small number of cases. Job losses from parts of the cavity and loft insulation market are likely. These costs have not been monetised.

| **BENEFITS (£m)** | **Total Transition** (Constant Price) Yea | **Average Annual** (excl. Transition) (Constant | **Total Benefit** (Present Value) |
|---|---|---|---|
| **Low** | Optional | Optional | **£21.2bn** |
| **High** | Optional | Optional | **£27.8bn** |
| **Best Estimate** | | | **£25.6bn** |

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

The main groups benefiting from the policy package will be those taking out Green Deals, those occupying properties with Green Deal plans, and those receiving support from the ECO. These groups will benefit from the energy savings (ranging from £12.7bn to £16.2bn) and from additional comfort (ranging from £2.8bn to £3.7bn). There are also benefits to wider society from improved air quality (£1.2bn to £1.6bn), non-traded carbon savings (£3.0bn to £4.8bn) and traded carbon allowance savings (£1.4bn to £1.5bn).

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

The health benefits arising from warmer homes have not been monetised, nor have any net increases in employment. Other instances include the benefits of the policy helping the UK to meet its renewables target more cost effectively than alternative methods, and the possible driving out of rogue traders from the construction sector. Jobs are likely to be created in the solid wall insulation market where demand is expected to rise steeply. These benefits have not been monetised.

**Key assumptions/sensitivities/risks** 3.5%

The Energy Company Obligations are quantity instruments requiring a certain level of savings to be achieved from installing measures. There is uncertainty over the costs to energy suppliers of meeting the obligations and the consequent bill impacts. There is also uncertainty over the take-up of measures through Green Deal finance. Sensitivities include fossil fuel prices, learning rates for installation costs and consumer demand.

**BUSINESS ASSESSMENT (Chosen Option)**

| **Direct impact on business (Equivalent Annual) £m:** | **In scope of** | **Measure qualifies** |
|---|---|---|

| | | | | |
|---|---|---|---|---|
| **Costs: 1,265** | **Benefits: 0** | **Net: 1,265** | Yes | IN |

**Table of Contents**

# 1. Executive Summary

This is a final stage Impact Assessment for the Green Deal and the Energy Company Obligation (ECO). The **Green Deal** is a novel financing mechanism and a framework of advice, assurance and accreditation for the energy efficiency supply chain for homes and businesses. It allows the cost of installing energy efficiency measures to be financed through a charge attached to a property's electricity meter. The **ECO** places three obligations on energy suppliers: a Carbon Saving obligation, a Carbon Saving Communities obligation (with a minimum Rural Safeguard target) and an Affordable Warmth obligation. These can be met by installing measures which reduce carbon emissions or energy bills, respectively, in the domestic sector. To meet the obligations suppliers will promote and subsidise measures.

Given the innovative and open market nature of the new Green Deal mechanism, the ability of the models used in this assessment to project with certainty the likely uptake of measures is limited. Take-up will be driven by market sentiment and the value people attach to energy efficiency measures in their homes and businesses, but there are reasons to suggest that, once the Green Deal Finance market gathers momentum, the take-up estimates suggested in this assessment could be cautious. As noted in Chapter 7, depending on other policy and market developments there is significant longer term upside potential for the market for energy efficient home improvements to develop beyond government forecasts. A key aim of the Green Deal is to move to a market framework where businesses and other organisations, in addition to energy suppliers, can compete for energy efficiency opportunities in new and innovative ways.

The Green Deal and ECO will work together to address market failures and barriers in the energy efficiency market, and open up the market to a diverse range of competitors. Regulations on energy efficiency are also likely to be introduced for the private rented sector, which will complement these policies. This IA assumes these regulations are likely to come into effect in 2018.

The Green Deal will ease credit constraints by providing low-rate finance, and help to improve trust across the supply chain for measures by providing a broad framework of advice, accreditation and quality assurance to give confidence to market participants and consumers. The ECO will provide a level of certainty on uptake of measures and complement the Green Deal by providing additional subsidy for measures which Green Deal finance alone would not deliver, but that are part of a socially cost-effective strategy for meeting the UK's carbon targets. ECO carbon targets will total 27.8Mt$CO_2$ between January 2013 and March 2015. This total carbon target comprises lifetime savings of 20.9Mt$CO_2$ for the Carbon Saving obligation target and 6.8Mt$CO_2$ for the Carbon Saving Communities target (of which at least 15%, or 1 Mt$CO_2$, must be delivered to rural households – the Rural Safeguard). Within the ECO, the Affordable Warmth obligation will provide insulation and heating measures in order to improve the ability of low income and vulnerable households to heat their home at an affordable cost. The Affordable Warmth target will require energy suppliers to

achieve a total reduction in lifetime notional space and water heating costs of £4.2bn by March 2015.

Implementation of the Green Deal and the ECO will accelerate improvement in the energy efficiency of buildings and thereby supports three Government objectives to:

- reduce UK Greenhouse Gas (GHG) emissions;
- address the drivers of fuel poverty; and
- maintain the security of UK energy supply.

The Green Deal and ECO consultation was published on 23rd November 2011 with a central proposal for these policies. More than 600 consultation responses were received. Following the responses received and further engagement with stakeholders some changes have been made to the final policy that is being legislated. The Government response published alongside this final impact assessment sets out the full detail of the responses received and final policy[1]. Specific changes relevant to the impact assessment are listed here:

For the Green Deal:

- **Consumer protection:** In view of the timetable for when the Green Deal framework becomes operational we will create a dedicated Green Deal Ombudsman service, instead of integrating ombudsman services within the Financial Ombudsman Service and Energy Ombudsman Service. Consumer protection has also been strengthened through a revised policy on assessor impartiality and cold calling, as well as protections for lower than average energy users. Options for disclosure and acknowledgement redress have also been developed, as has the policy on appeals. More detail is set out in the Government Response.
- **Provider authorisation costs:** Excessive burdens on Green Deal providers have been removed, to facilitate market entry and prevent unnecessary red-tape costs. Consumers will be protected in case of provider insolvency or loss of authorisation through amendments to the Green Deal Arrangements Agreement, and including requirements in the Green Deal Framework Regulations. The warranty requirements have been simplified, requiring providers to include a minimum 5 year warranty for all measures installed plus 10 years of cover for consequential building damage, the exceptions being solid wall insulation (SWI) and cavity wall insulation (CWI) which will require 25-years' cover. Cost-effective warranties are already available in the market for both CWI and SWI so Green Deal Providers could make use of these as part of their offering to consumers if they meet the requirements in the Code of Practice and Green Deal Framework Regulations. In addition, we have also removed the requirement for Green Deal providers to have an independent conciliation service in place to offer customers an alternate route of redress. Instead customers will have access to the Green Deal Ombudsman service. These changes in policy will remove additional costs for Green Deal providers and customers whilst still ensuring appropriate consumer protections are in place. We have also amended the suggested policy on additional consumer protections where Green Deal finance offered is in excess of £10,000. We have removed the requirement for Green Deal providers to reduce the energy

[1] See http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx

savings estimate by 5% but are keeping the obligation for Green Deal providers to ensure customers have received at least 3 quotes where possible.

- **Green Deal finance charge:** We are only allowing fixed rate Green Deal plans to be offered to domestic customers. However, in order to seek to maximise the potential volume of eligible measures we are proposing to permit the whole charge to rise by 2% every year. The schedule of repayments would be fixed at the outset so all future repayments will be visible to the customer at the start at of the plan.
- **Measures and products:** Following the consultation, the list of eligible measures has been extended from 30 to 45 measures**.** The new measures are particularly relevant to the non-domestic sector. In relation to product assurance, we have included a new provision in the Code of Practice to require that Green Deal Providers confirm with their suppliers that the products to be installed in a Green Deal property are a type capable of – or designed to - deliver the level of fuel bill savings estimated for the "measure" during the Green Deal Assessment. This means consumers can be confident the products installed should deliver the estimated energy savings. We will no longer require registration of all Green Deal products but will continue to require that spot-checks for compliance are undertaken. This will result in significant administration savings and ensure legal compliance with EU laws.
- **Supplier licence proposals:** The consultation stage Impact Assessment proposed an annual fee of £3 per Green Deal Plan to be paid by providers to energy companies for routing Green Deal charges to finance providers. Following consultation, fees now will be charged at the rate of 1p/plan/day invoiced on a quarterly basis which simplifies fee calculation. We have decided to allow smaller suppliers to collect a higher fee of 2p/day/plan from providers which will make it easier for them to compete, but a levelisation procedure will operate which ensures that Green Deal providers pay no more overall, in any one quarter, than 1p/day/plan. It has also been agreed with stakeholders that Green Deal Providers will pay for use of the existing Data Transmission Network, as opposed to the development of a new secure method for data transfer. Through consultation, this was decided to be the best value for money option for secure transfer of data between the new central charge database and its users (suppliers and Green Deal providers).

In addition, the following has been clarified through the consultation process, leading to a change in modelling assumptions:

- **Assessments:** The consultation stage Impact Assessment assumed that those households commissioning Green Deal assessments who did not proceed to take-up a Green Deal paid for the assessments up-front. In the central case in this IA, it is assumed that some of the assessment costs will be paid upfront when households do not take out a Green Deal, while the rest of these costs are recovered from Green Deal customers. The market is likely to develop a range of business models, however. While paying a proportion of costs up-front for assessments decreases the numbers of assessments, it would be expected to increase the take-up rate for measures, as some of the costs of failed assessments will not be passed on to those taking out the Green Deal, increasing the proportion of measures meeting the Golden Rule.

The reasons for and implications of these changes are discussed in Annex G.

For the **ECO**:

- **The balance between the Affordable Warmth target and the Carbon Savings target:** The ECO will consist of an Affordable Warmth target, a Carbon Savings target and an area based Carbon Saving Communities (CSC) target focused on the delivery of carbon reduction measures to the 15% most deprived areas and eligible rural households in Great Britain. Within the CSC, suppliers will be required to deliver at least 15% of their CSC obligation to households in rural areas who are in receipt of specified means tested benefits (the 'Rural Safeguard' target). The CSC obligation is expected to result in delivery of around 47% of the insulation measures supported through ECO to low income and vulnerable households.
- **ECO eligibility criteria**: A number of consultees expressed concern about discontinuation of subsidy support for all CWI and loft insulation (LI), and emerging evidence on SWI suggests that its cost-effectiveness is lower than assumed in the consultation assessment[2]. The final eligibility criteria for the three obligations are:
    - Affordable Warmth obligation: The eligibility criteria are as specified in the consultation document and have been broadened to include some households on Working Tax Credit and raising the age threshold for households with children from age 15 to children aged 16 (or in full time education).
    - Carbon Savings obligation: Hard to treat CWI and SWI (and other insulation measures packaged with these) are eligible. The eligibility criteria were broadened to include a subset of CWIs that are unlikely to meet the Golden Rule[3] without subsidy. An ECO policy option that included *all* CWI and LI was also modelled. Although this option could, in the short term, lead to higher carbon savings (19% greater savings p.a. in March 2015) and have a greater net present value, it presents a significant trade-off risk for Green Deal finance, with the potential to undermine the delivery of the wider Green Deal programme. (As noted above, there are reasons to believe that, once the Green Deal market gathers momentum, take-up estimates currently suggested could be cautious, with cope for more measures which under this option would be promoted under ECO to be delivered in fact by Green Deal, with the beneficiary rather than the general bill payer meeting the costs). Such a broadening of the scope for ECO eligible measures would probably lead to a large share of ECO being spent on measures that could have otherwise been delivered with Green Deal finance only, as they meet the 'golden rule'. This would have a negative impact on the Green Deal finance market and put at serious risk the development of the future solid wall insulation market (see section 3.6 for more details) with implications for longer term cost effective carbon savings. These tradeoffs are discussed in more detail in Annex H.
    - Carbon Saving Communities obligation: All insulation measures, including all CWI and LI are eligible. Suppliers are required to deliver measures to households in the most deprived areas (i.e. the bottom 15% measured on the English, Welsh and Scottish

[2] DECC has taken new evidence into consideration that shows there is a larger variability in savings from SWI amongst different households than previously assumed. Whilst SWI still has a large potential for saving energy in comparison to most other measures, it is also very costly. The variability combined with high costs, make SWI on the whole, less cost-effective than previously assumed in Green Deal and ECO consultation IA. For more details on the variability on SWI energy savings that has been modelled – see Annex A

[3] Please see section 'More detail on the Green Deal' in 3.5 for a full description of the Golden Rule.

indexes of Multiple deprivation. Up to 20% of the activity undertaken by suppliers to meet this target can be in adjacent areas. Suppliers can also assist households in rural areas (i.e. in settlement with fewer than 10,000 inhabitants) who are in receipt of one of the Affordable Warmth qualifying benefits. They are required to deliver at least 15% of the CSC obligation to these low income households in rural areas.

- **Allocation of the obligation:** Suppliers with a customer base of less than 250,000 customer accounts will be exempt from the ECO. We will divide the ECO between energy companies on the basis of their share of gas and electricity supplied, as this is expected to result in an improvement in the distributional impacts of the policy compared to the consultation proposal. The obligation will be tapered for suppliers passing through the qualification threshold to support competition in the retail energy market.

Further details on these policy decisions are provided in Annex H.

Table 1, below, shows how the estimated take-up of measures under the central scenario has changed between the consultation IA and this IA; by changing the modelling methodology only, and by changing the policy mix as well. Overall, the impact of these changes has been to reduce the projected number of solid wall insulation installations, and increase the number of cavity wall and loft insulations expected to be taken up since the consultation IA. There is a high level of uncertainty associated with these uptake projections, due to the innovative and market based framework of the Green Deal.

**Table 1: Cumulative take-up of measures to March 2015 ('000s)**

| Measure | Consultation IA | Final IA ( Consultation policy proposal with updated methodology) | Final IA's policy mix |
|---|---|---|---|
| Solid Wall Insulation | 377 | 275 | 147 |
| Cavity Wall Insulation | 664 | 410 | 830 |
| Loft Insulation | 202 | 247 | 364 |

The Impact Assessment uses models which are based on information from consumer surveys designed to reveal preferences towards the main energy efficiency measures. Demand modelling has used these stated consumer preferences to estimate the level of subsidy that would have to be offered by suppliers to attract sufficient demand to meet their ECO targets. Further details on the Green Deal Household Model are in Annex B. The model attempts to capture the combined impacts on demand of the various aspects of the policies, not just the price elasticity of consumer demand. This paper assesses the impacts of the final policies that will be legislated. These impacts are compared to a counterfactual where the policies are not introduced (discussed in section 6).

The policies are estimated to lead to a carbon saving of 0.38$MtCO_2$ p.a. by March 2015 and 1.8$MtCO_2$ $MtCO_2$ p.a. by 2020, and have a positive Net Present Value of £8.3billion.

**Table 2: Headline central estimates of social impacts of the Green Deal and ECO (£m unless otherwise stated)**

| | Central estimate |
|---|---|
| Installation costs (m) | £10,121 |

| | |
|---|---|
| Additional costs | £3,468 |
| Assessment costs | £1,214 |
| Finance costs | £1,522 |
| Cost to business (excluding ECO) | £945 |
| Administration costs | £40 |
| **Total costs (£m)** | **£17,311** |
| Energy savings (Variable element) | £14,988 |
| Comfort benefits | £3,450 |
| Air quality benefits | £1,434 |
| Lifetime non-traded carbon savings | £4,272 |
| Lifetime EU Allowance savings | £1,471 |
| **Total benefits (£m)** | **£25,616** |
| **Net Present Value (£m)** | **£8,305** |
| Equity-weighted NPV | £20,241 |
| 2020 Non-traded carbon savings ($MtCO_2$ pa) | 1.8 |
| Life time non-traded carbon savings ($MtCO_2$) | 84 |
| **Cost effectiveness £/$tCO_2$** | -£48 |

The uptake of the key energy efficiency measures are shown in Figure 1 below. It is estimated that around 960,000 SWI, 2,700,000 CWI and 1,640,000 LI installations would be taken up by the end of 2022, in addition to around 1 million heating measures as part of the Affordable Warmth obligation.

The ability of models to fully capture the likely uptake of measures is limited, given the innovative and open market characteristics of the Green Deal and ECO policy framework. The Green Deal will enable the development of new business models and delivery systems, therefore predicting the uptake of Green Deals in the market is inherently difficult (see section 7.1 for detailed discussion). This means there is inevitable uncertainty around the take-up estimates presented in this Assessment. Given the uncertainties surrounding the development of this market, the figures presented above are a central assumption; however, the range of possible scenarios is very broad (see section 7.5 for sensitivity analysis). Greater certainty will emerge as the evidence base develops over the next few years. As the ECO is a quantity-related obligation, the total carbon savings delivered through this mechanism are relatively certain, but the mix and costs of the measures

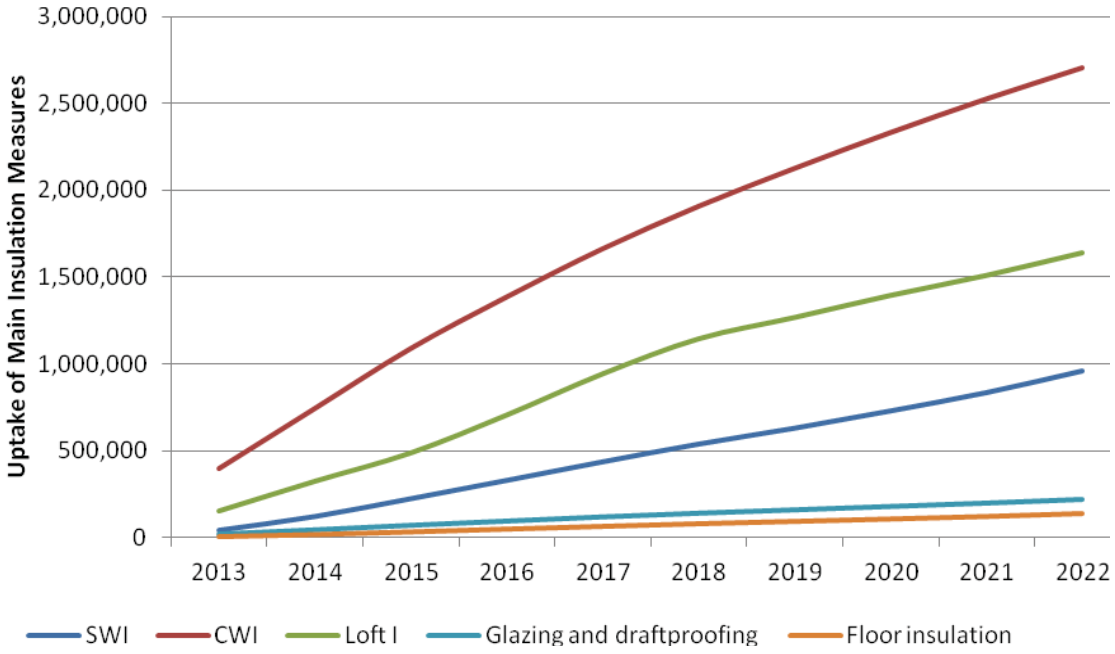
delivered are less so. The uncertainty around the costs to energy suppliers of achieving their obligations relates particularly to energy prices and consumer preferences. Sensitivity analysis to assess the impact of these uncertainties shows that the actual costs of delivering the ECO target varies considerably between scenarios, and that the uptake of measures wholly financed by Green Deal only also varies. These uncertainties will be managed by a strong monitoring and evaluation of the policies. As we develop our approach to monitoring and evaluation of the Green Deal and ECO, we will publish further details. Outside the ECO mechanism there is also less certainty of take-up, as this will be driven by market sentiment and the value people attach to energy efficiency measures in their homes and businesses. Nevertheless, there are strong reasons to suggest that, once the Green Deal Finance market gathers momentum, the take-up estimates suggested in this assessment could be cautious.

In response to the consultation, there were concerns about the discontinuation of subsidy support for CWI and LI. We have decided to include hard to treat cavities (and lofts if bundled with them) in the Carbon Saving obligation and establish a new Carbon Saving Communities sub-obligation, under which all insulation measures will be eligible. Modelling estimates suggest that this could lead to the insulation of an extra 540,000 lofts and cavities by March 2015 – suggesting a greater mix of types of insulation and smoothing the transition from easier to treat insulation to SWI. Industry responses to the consultation have suggested that the reduction in basic insulation measures (CWI and LI) may induce loss of jobs and closure of manufacturing capacity, given that skills and resources could not be expected to be redeployed in the SWI sector. However, support for hard to treat CWI and SWI which are more labour intensive than easy to treat CWI and LI, is expected to compensate for any reductions in capacity and to increase the number of jobs in the insulation sector to around 39,000-60,000 by 2015 (see section 7).

It is estimated that the cumulative volume of Green Deal finance would be between £1.1bn and £1.3bn by 2015 and between £3.2bn and £4.1bn by 2022[4].

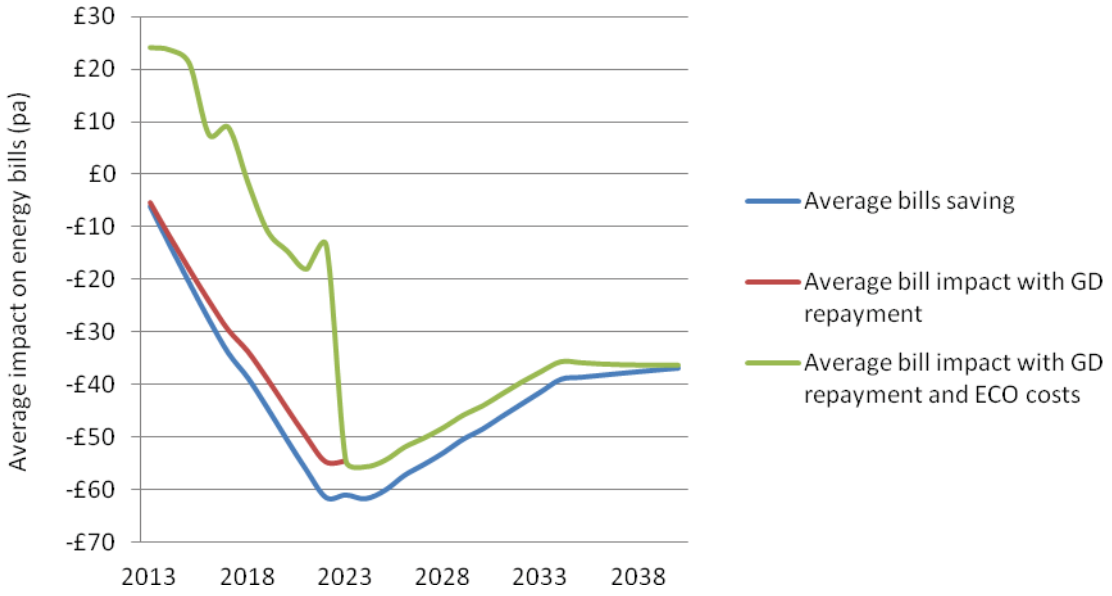
[4] This is assuming all privately financed measures use Green Deal finance to fund them.

Figure 1 Cumulative uptake for main energy efficiency measures in the domestic sector up to 2022, including BAU




The estimated impact on average domestic energy bills is shown in Figure 2. The costs of measures delivered by Green Deal finance will be borne by the beneficiaries of the measure, but the ECO will be funded through energy bills. This means that, in the nearer term, average bills (green line) will increase as measures begin to be rolled out, compared to no policy. However, households currently pay for energy companies' CERT and CESP compliance through their energy bills, so the impact compared to existing bills is likely to be small. In the longer term, as more households experience bill savings from the measures installed and the costs of ECO are no longer recouped through energy prices, average bills will decrease overall for a sustained period of time. The final ECO policy design is estimated to lead to a broadly similar impact on energy bills as a percentage of average income across most income deciles (see section 8.7).The uncertainty of the overall distribution of ECO benefits is discussed in Annex H.

**Figure 2 Average domestic energy bill marginal impact from Green Deal and ECO**



## 2. Introduction

This final stage Impact Assessment accompanies the Government Response to the Green Deal and the Energy Company Obligation (ECO) consultation which ran from November 23 2011 to January 18 2012. Evidence gathered from the more than 600 consultation responses has informed policy development and the estimates of the costs and benefits of the policies that are being implemented.

The document has the following structure:

- The **Rationale for Government Intervention** section sets out the objectives that improved energy efficiency would help to achieve, and the market failures and barriers that depress uptake of energy efficiency measures (section 3). It also describes the reasons behind the shift in support towards more hard to treat measures, how the policies will work together and alternative policy options.
- The **Background on Current Policies and Energy Efficiency Market** section covers the current policy context and the market for energy efficiency measures in both the domestic and non-domestic sectors (section 4).
- The **Analytical Approach** section explains the analytical methodology adopted, including the use of three models to project the impact of the policies: The Green Deal Household Model, the Affordable Warmth model and the non-domestic Green Deal model (section 5).
- The **Counterfactual** section sets out projections for take up of energy efficiency and heating measures in the absence of the Green Deal and ECO policies (section 6).
- The **Aggregate Impacts** section provides the assessment of the impacts of the Green Deal and the ECO relative to the counterfactual. This includes a central assessment of the impact of the policies on carbon emissions, energy consumption, employment and installation of measures as well as a distributional analysis. Sensitivities on the projections are analysed and the uncertainty over the costs, benefits and distributional impacts of the policies set out (section 7).
- The **Green Deal mechanism** section sets out the costs associated with the Green Deal's framework of advice, accreditation and assurance (section 8).
- The **ECO** section sets out the costs associated with administering the ECO scheme (section 9).
- The **Wider Impacts** section provides an assessment of a range of further impacts including on health, sustainability, equality, competition and rural communities (section 10).
- The **Post Implementation Review** section summarises the evaluation strategy that DECC is implementing to monitor the Green Deal and the ECO and inform the policy (Annex K).
- Finally the **Annexes** provide further detail on the analytical inputs, methodology and policy decisions.

# 3. Rationale for Government Intervention

## 3.1. Objectives supported by improved energy efficiency

1. Implementation of the Green Deal and the ECO supports three Government objectives, to:
    - reduce UK Greenhouse Gas (GHG) emissions;
    - maintain the security of UK energy supply; and
    - address the drivers of fuel poverty.

2. GHG emissions from buildings (domestic and non-domestic) were 93Mt$CO_2$e direct and 111Mt$CO_2$e indirect in 2009. This was 43% of total UK GHG emissions. Carbon budgets and the UK's 2050 target[5] will not be able to be met without reductions in emissions from the built environment. Emissions can be reduced by:
    - reducing the carbon intensity of energy supply;
    - improving the efficiency with which energy services are produced; and
    - reducing demand for energy services.

   Analysis indicates that there is substantial cost-effective energy efficiency potential. The costs of meeting carbon budgets will be substantially increased if this potential cannot be delivered.

3. The UK is increasingly dependent on fossil fuel imports, with the result that the UK is becoming more exposed to risks from rising global demand, limitations on production and price volatility. UK production of oil and gas has fallen from 134% of national demand in 2000 to 76% of demand in 2010. Published projections show a further fall to 52% in 2020[6]. Improved energy efficiency reduces the UK's demand for fossil fuel.

4. Improving the thermal efficiency of domestic properties addresses a root cause of fuel poverty. A household is currently defined as fuel poor if it would need to spend more than 10% of its income on adequate energy services [7]. The Government has a statutory target to eradicate fuel poverty, as far as reasonably practicable, in England by 2016. Estimates suggest around 3.9 million households were fuel poor in England in 2012[8]. The Scottish Government has a target to eliminate fuel poverty as far as is reasonably practicable by 2016 and the Welsh Assembly Government has a target to ensure that no household is living in fuel poverty by 2018.

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[5] The Climate Change Act 2008 sets a legally binding target of an 80% reduction in emissions relative to 1990 levels by 2050.

[6] https://www.og.decc.gov.uk/information/bb_updates/chapters/production_projections.pdf

[7] In terms of levels of warmth, this means achieving certain temperature standards (defined as 21°C for the main living area and 18°C for other areas), for a certain amount of time each day, depending on a household's circumstances. Allowances are also made for what a household needs to spend for water heating, lighting and cooking The Government is committed to adopting a new definition of fuel poverty for England following the Hills Fuel Poverty Review. There will be a consultation in late 2012. For more on the Hills Fuel Poverty Review see: http://www.decc.gov.uk/en/content/cms/funding/fuel_poverty/hills_review/hills_review.aspx.

[8] http://www.decc.gov.uk/en/content/cms/statistics/fuelpov_stats/fuelpov_stats.aspx

5. Energy efficiency improvements can also have further benefits including:
    - where cost-effective, energy efficiency measures in the non-domestic sector can improve productivity, with the potential to boost growth and business competitiveness;
    - many low income and vulnerable households under-heat their homes relative to need. Living in cold conditions is linked to a number of detrimental mental and physical health impacts. Improved thermal efficiency, leading to increased indoor temperatures, has a positive impact on the health and wellbeing of household members.

6. In December, the Government published the Carbon Plan, outlining its strategy to meet the UK's decarbonisation objectives. Heating and powering the UK's building stock is currently responsible for over a third of the UK's emissions, but the building sector will need to be almost completely decarbonised by 2050 in order to cost-effectively meet our objectives. Reducing energy demand is the cheapest means to cut emissions, and energy efficiency measures make it possible to cut bills alongside emissions.

7. This Impact Assessment estimates that up to 1 million solid wall insulations will be completed by 2022. It also estimates that 1.2m easy to treat cavities will be filled out of the current potential of 2.6m. Including loft top-ups of around a quarter of the 6m potential and the non-domestic sector's abatement, this contributes 9 $MtCO_2$ of savings within the second Carbon Budget period and a further 16 $MtCO_2$ to the third (see Table 3).

**Table 3: Contributions to Carbon Budgets**

| | Carbon Budget Period | |
|---|---|---|
| | 2: 2013-17 | 3: 2018-22 |
| **Legislated Budget ($MtCO_2e$)** | 2,782 | 2,544 |
| **Reduction Required from Previous Budget ($MtCO_2e$)** | 236 | 238 |
| **Contribution expected from domestic sector ($MtCO_2e$)[9]** | 6.3 | 9.0 |
| **Contribution expected from non-domestic sector ($MtCO_2e$)[10]** | 2.5 | 6.5 |

[9] Carbon savings of 15.4$MtCO_2$ delivered in Carbon Budget 3, but 9$MtCO_2$ is the additional abatement delivered over and above their contribution in the previous carbon budget period.
[10] Carbon savings of 9 $MtCO_2$ delivered in Carbon Budget 3, but 6.5$MtCO_2$ is the additional abatement delivered over and above their contribution in the previous carbon budget period.

## 3.2. Market failures and barriers

8. There are market failures and barriers which could reduce the take up of energy efficiency measures to below the socially optimal level. A number of these are addressed or reduced by the Green Deal and the ECO:
    - **Prices do not reflect negative externalities:** externalities associated with GHG emissions are not fully reflected in the price of energy. Private decisions to consume energy will not consider the wider social impacts of emissions leading to over-consumption.
    - **Access to capital:** Many households and some organisations cannot access conventional finance markets to fund energy efficiency improvements, while other households and organisations may face high costs of capital that do not reflect the particular nature of energy efficiency investments i.e. a reliable stream of bill savings.[11] These households and organisations are credit constrained with their opportunity cost of investments in energy efficiency measures exceeding the social discount rate. This leads to under-investment in energy efficiency capital compared to the social optimum.
    - **Lack of information and information asymmetry:** a market failure preventing the take-up of cost effective measures is the lack of trusted information for consumers (including businesses) who do not have easy access to, or a full understanding of, information on energy efficiency measures available to them[12] [13] [14]. Consumers may not feel confident in assessing the risk of buying a poor quality service and may prefer to withdraw from the market or heavily discount the claimed savings from energy efficiency measures[15].
    - **Positive externalities:** by creating a bigger market in the installation of energy efficiency measures, the Green Deal could create the positive externality of reducing installation costs for future time periods. Learning by doing could create productivity improvements either through installers improving their installation processes or if manufacturers develop systems that are easier to install. Because households and organisations do not value these benefits at the point of their own consumption, if left alone the market for energy efficiency measures would deliver a socially sub-optimal outcome. There would be lower deployment and persistently higher costs for energy efficiency measures. Intervention to promote deployment could address the market failure.
    - **Social and psychological inertia:** energy consumers may be slow to change behaviour or adopt energy efficiency technologies even when, from an objective viewpoint, they offer

[11] DECC's Green Deal Consumer Survey (2011) shows that the main reason people are prevented from making their homes more energy efficient is a lack of money.

[12] Royal Institute for Chartered Surveyors (2010) "Energy Efficiency and Value Project" noted a lack of consistent or easy to access information on energy efficiency and that this influenced a low level of demand for energy efficiency measures.

[13] DECC's consumer research (2011) shows that after requests for lower costs, having access to convincing information about benefits and information from a trusted source are the main reasons given for what would encourage people to make their homes more energy efficient (see Annex D).

[14] It is important to note that under the Energy Performance of Building Regulations, there is a duty on estate agents to disclose either the Energy Performance Certificate (EPC) in full or the EPC property asset rating, along with the written particulars of a domestic property which is on the market for sale. This implements the Energy Performance of Buildings Directive. The Department for Communities and Local Government (CLG) is considering proposals to amend the regulations to remove the element of choice (creating an obligation on agents to produce the EPC at the same time as the written particulars). CLG is also considering proposals to extend the regulations to cover the non-domestic and rental sectors. These proposals would improve the information available to consumers and support Green Deal objectives.

[15] Akerlof (1970) "The Market for Lemons", Quarterly Journal of Economics

benefits to the consumer[16]. The concept of bounded rationality explains some of this inertia, i.e. that consumers can only cope with a limited amount of information at any one time. However, cultural and other psychological factors are also likely to have a role to play, such as aversion to a perceived debt and social norms. The presence of real, but "hidden" costs, for example the real costs of devoting the time required to assess potential investment options, will also explain some inaction. This is true for households and particularly for organisations, for whom management time and attention is a more closely monitored scarce resource.

- **Misaligned incentives:** examples of misaligned incentives for energy efficiency of buildings are the landlord-tenant or the builder-homebuyer relationships. In both cases the first party decides the level of energy efficiency of the building while the second bears the costs associated with energy consumption. Faced with this barrier individuals are encouraged to only consider the investment case for energy efficiency measures for the length of their own expected tenure. Improved energy efficiency performance of buildings reduces the ongoing operating costs for the property. In principle, this should be capitalised in the value of the property or reflected in the rental value, generating value from energy efficiency investments for the builder or landlord. This would therefore overcome the misaligned incentives barrier. However, the energy efficiency of the property is relatively marginal relative to other characteristics such as size and location. The Royal Institute of Chartered Surveyors suggest that there is currently little demand for energy efficiency from UK home buyers and, as such, market participants do not assign value to it[17].
- **Time inconsistent private discount rates:** Hyperbolic, or time inconsistent, private discount rates may prevent the uptake of energy efficiency measures. High short-run private discount rates[18], mean that consumers are likely to value up-front capital costs substantially more highly than future bill savings, resulting in under-investment in energy efficiency capital.

### 3.3. Distributional rationale

9. Expenditure on energy – including essential components such as heating – can represent a disproportionate share of available resources for different groups in society. Typically for those households with the fewest resources spending on energy represents a greater proportion of their budget than for better off households.[19] High energy bills, compounded by energy inefficient homes, are regressive in that a low income households would need to spend a

[16] 19% of people that have not installed basic, low cost, insulation measures are completely unengaged with the issue. Defra
(2009) Public Attitudes and Behaviours Towards the Environment Survey 2009 and Energy Saving Trust (2009) Qualitative
Research.
[17] Royal Institution of Chartered Surveyors (2010) "Energy Efficiency and Value project"
[18] Individuals' discount rates have been observed to be inconsistent over time and can be described by hyperbolic discount functions, where the rate of pure time preference is initially very high but declines over time (Frederick, Loewenstein and O'Donoghue 2002).
[19] See DECC (2011), "Estimated impact of energy and climate change policies on energy prices and bill", Chart 10, available at: http://www.decc.gov.uk/assets/decc/11/about-us/economics-social-research/3593-estimated-impacts-of-our-policies-on-energy-prices.pdf

greater proportion of their income to pay the same bill than a more wealthy household. Addressing the thermal efficiency of homes, particularly those lived in by low income households, will help mitigate disparities between different groups as well as overcoming financial constraints that prevent some households from upgrading the efficiency of their homes independently.

10. The Hills Fuel Poverty Review, published in March 2012, concluded that the thermal efficiency of homes is a key driver of fuel poverty, and that fuel poverty itself is a serious problem.[20]

11. Professor Hills found that while energy efficiency was not the only driver of fuel poverty, delivering energy efficiency and heating measures provide the greatest long term impacts on reducing the extent and depth of fuel poverty. In 2009, around 55% of houses with a Standard Assessment Procedure (SAP) rating of 30 or below were lived in by fuel poor households and around 60% of all fuel poor households reside in a home with a SAP of 50 or below, indicating that there is significant scope for energy efficiency to contribute to reducing fuel poverty.[21]

## 3.4 Cost effectiveness rationale

12. In order to meet the UK's carbon challenges, the Government aims to promote the most cost effective energy efficiency measures. It must do this in an efficient way, however, by encouraging cost reductions from learning and economies of scale in those technologies on which the bulk of future carbon abatement will rely.

13. Around 15% of the domestic sector's remaining abatement potential lies in relatively inexpensive loft top-up insulation and easy to treat cavity wall insulation; the remaining potential is split between solid wall insulation (67%) and hard to treat cavity wall insulation (18%). In order to tap into the bulk of this potential in a cost effective way, policies now need to focus on supporting these more costly measures to start driving their costs down.

14. Including all insulation measures in a single obligation mechanism is unlikely to achieve this aim, as the least costly measures would be targeted first. Then, as their remaining potential becomes harder to find, the incentives on offer to the remaining easy to treat households are likely to rise well above the cost of the measures themselves[22], and delay further the take-up

[20] In Spring 2011, the DECC Secretary of State commissioned Professor John Hills from the London School of Economics to carry out an independent review of the fuel poverty definition and target. Professor Hills' final report, published in March 2012, concluded that fuel poverty is a serious problem and recommended changing the approach to measuring fuel poverty. The Secretary of State for Energy and Climate Change has committed to the adoption of a revised approach to measuring fuel poverty in England by the end of the year and to the publication of a consultation on the new approach that the government will propose in late 2012.

[21] DECC (2012). "Annual Report on Fuel Poverty Statistics 2012", Available at: http://www.decc.gov.uk/en/content/cms/statistics/fuelpov_stats/fuelpov_stats.aspx

[22] The total delivered cost of an insulation measure within a compliance obligation mechanism, such as ECO or CERT, is likely to be significantly higher than the cost of the measure's labour and materials. This is because of the costs of the mechanism (Green Deal mechanism costs, assessments etc.), search and advertising costs to identify appropriate households, and any financial inducements required to overcome households' barriers such as inertia or hidden costs. As remaining abatement potential declines, these delivery costs rise even if the installation costs are stable.

of more costly measures[23] (see figures, below, and section 9.1 for a fuller discussion of how different costs of abatement benefit those offering the cheapest form of abatement); bringing about large transfers from energy bill customers to households with low cost abatement measures. The net result of which is little support for solid wall and hard to treat cavity wall insulation and further postponement in delivering their cost reductions (although cost reductions are not explicitly modelled in the IA). This is also the case if only loft insulation was allowed alongside the more costly measures (i.e. excluding easy to treat cavity wall insulation); there could also be an incentive to game the system by removing existing loft insulation if there were financial inducements to do so.

**Figure 4: CWI uptake and potential**

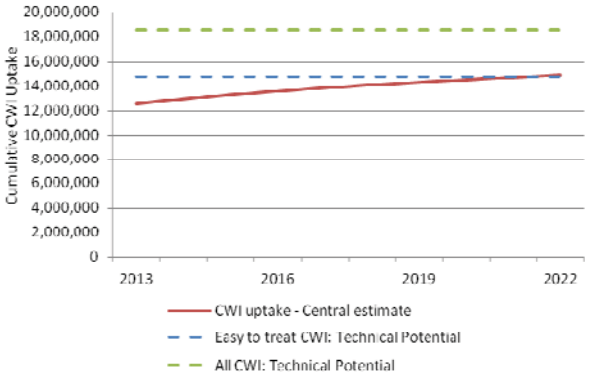



**Figure 3: SWI uptake and potential**

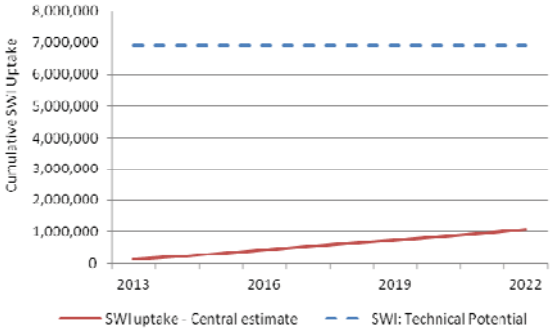
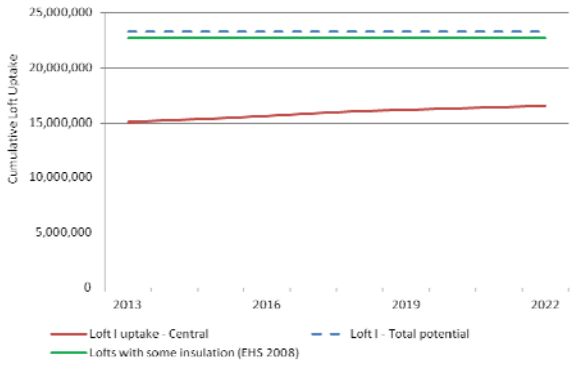



**Figure 5: LI uptake and potential**




## 3.5 Description of the policies

15. The Green Deal and the ECO are two complementary policy interventions.

16. **The Green Deal** allows householders and organisations to install energy efficiency measures at no upfront cost. Installation costs are financed by Green Deal Providers who recoup these

[23] There is evidence in the market that energy companies are currently offering households free insulation plus additional financial inducements under their existing obligations. Although solid wall insulation is an allowed measure to comply with energy companies' existing obligations, support for it is at very low levels.

costs, including interest, through a charge attached to the property's electricity meter. The policy also provides a framework of advice, assurance and accreditation covering the whole supply chain.

17. The **ECO** places obligations on suppliers to meet two carbon targets (one of which includes a rural sub-target) and an Affordable Warmth target in the domestic sector. The actual total carbon target runs between January 2013 to March 2015 and is 27.8Mt$CO_2$ (split into 20.9Mt$CO_2$ for the Carbon Saving Obligation target and 6.8Mt$CO_2$ for the Carbon Saving Communities target, of which at least 1 Mt$CO_2$ must be delivered to rural households – the Rural Safeguard target). The Affordable Warmth target will require energy suppliers to achieve a total reduction in lifetime notional space and water heating costs of £4.2bn. The targets can be met through a combination of promotion and subsidy. Suppliers can generate their required ECO points either directly, by installing eligible energy efficiency and heating measures, or indirectly by contracting with installers of these measures, for example through a brokerage platform. Previous obligations have shown that subsidy is used to incentivise demand for measures. This could either be direct from suppliers or, via the contracting process, through a third party installer using the funding they receive as part of their contract to deliver ECO measures.

18. The scope of the targets are defined by the eligibility of measures to generate ECO credit or points. This in turn decides which measures could receive subsidy. From the householder's perspective, the subsidy can work together with the Green Deal. A quote from a Green Deal provider or other delivery agent for the installation of measures will be net of any ECO subsidy that is available, reducing the amount the householder would need to finance through the Green Deal or other funding sources. Energy suppliers will also be able to fully subside the installation of measures when this is considered necessary to meet the targets.

## More detail on the Green Deal

19. An accredited impartial assessment of the property provides the gateway to the Green Deal. Advisors will be qualified to the standards set out in the National Occupational Standards for Green Deal Advisors and certified against the advice standard. All advisors will use an approved Green Deal Assessment tool and provide an assessment of the measures which could be installed in a property, the estimated energy savings that they would achieve and the likely eligibility and level of Green Deal finance that could be accessed to cover the cost of their installation. In the domestic sector the tool will be based on the Reduced Data Standard Assessment Procedure (RdSAP) and in the non-domestic sector the Simplified Building Energy Model (SBEM). In the domestic sector the assessment will include an additional occupancy assessment in addition to a fabric assessment[24] to provide feedback to householders about whether their energy use is likely to be above or below that of the typical household. In the non-domestic sector, consideration of occupancy factors will be built into the Green Deal SBEM tool.

[24] A fabric assessment is analysis of the energy performance of the building itself based on factors such as its physical dimensions, the type of construction (e.g. solid walls, cavity walls, double glazing etc), the nature of the heating and ventilation systems and lightning, and existing energy efficiency measures in place.

20. A key principle of the Green Deal is that the consumer can shop around with the results of the assessment. This ability to compare offers is important, if the Green Deal is to be competitive and offer best value for the consumer. However, if Green Deal Providers carry out an assessment that is immediately available for all competitors to access, this will act as a disincentive to provide assessments at no or low cost. We are exploring options for a short grace period for Green Deal Providers between carrying out an assessment and lodgement, to prevent free-riding by competing suppliers. Discussions with stakeholders are ongoing. Given that discussions will focus on the potential to relax the lodgement timetable, the costs to business will not increase as a result.

21. Following an assessment, occupants who are interested in taking out a Green Deal can approach multiple Green Deal Providers for quotes. Accepting a quote will initiate a Green Deal plan, which is a contract between the Provider and the bill payer. The plan sets out the repayment term for the Green Deal and the level of the charge that would be attached to the electricity meter if the financing offer were accepted. For tenants, permission will have to be gained from the property's owner. Should the occupant of the property change, then the Green Deal plan and liability for the charge passes to the new occupants. In between tenancy periods, the landlord would be responsible for paying the Green Deal plan until the new tenant takes over. A system of disclosure and acknowledgement provides safeguards for the transfer of the plan. Installation will be carried out by authorised installers who will have been certified to meet the new installer standard.

22. The framework of assurance and accreditation is set out in the Green Deal Code of Practice. The Green Deal market is voluntary, but to participate assessors, installers, manufacturers and Green Deal providers all have to meet the required standards. This provides assurance to householders and organisations of the quality of the Green Deal offer.

23. The 'Golden Rule'[25], which caps the charge placed on the electricity meter, is an important principle of the policy. It states that bill savings in the first year must exceed the Green Deal repayment and that the repayment term must not exceed the expected lifetime of the measure. As such, by providing some assurance that bill savings will exceed repayments for the lifetime of the plan, energy bill default rates should not increase as a result.

24. The maximum installation cost that a Green Deal Provider will be able to finance through the Green Deal finance mechanism is limited by the repayment structure. In year one, the Green Deal charge is capped at the level of expected bill savings, in compliance with the Golden Rule. It is then allowed to rise by 2% per year in nominal terms. It is anticipated that Green Deal providers will ultimately access the capital markets to fund the installation of the measures. To achieve this, Green Deal providers are exploring options to aggregate Green Deals into a Special Purpose Vehicle (SPV). The vehicle would raise capital from investors to fund Green Deals and repay this using the Green Deal repayments. Current indications are that such a

[25] See Annex G or the consultation stage IA for further description of the Golden Rule

vehicle could deliver a cost of capital of around 7.5%, significantly lower than would be expected for other forms of unsecured personal finance (see Annex I for more detail).

## More detail on the ECO

25. The ECO will require energy suppliers to promote the installation of measures that are either part of a cost-effective strategy for meeting the UK's carbon target, or that reduce heating costs for low income and vulnerable households, helping to tackle fuel poverty.

26. The ECO has separate legal obligations: to provide measures specifically intended to reduce GHGs (the 'Carbon Saving' target and the 'Carbon Saving Communities' target with a 'Rural Safeguard' minimum target), and supply measures intended to improve the ability of low income and vulnerable households to heat their homes at affordable cost (the 'Affordable Warmth' target).

27. Each obligation uses target metrics based on the SAP methodology which underpins the assessment tool for the Green Deal as the basic EPC. The carbon reduction targets are set in terms of assessed lifetime $CO_2$ reduction from the installation of eligible measures, and the Affordable Warmth target is set in terms of assessed lifetime notional heating cost reductions. When within scope of an obligation, an installation will generate a number of 'ECO points' in line with the EPC. (See annex H for details.)

28. For each obligation, the Secretary of State is setting a Great Britain-wide level of ambition (or number of ECO points) which the ECO administrator will distribute to the obligated energy suppliers based on their market share. The allocation methodology is described in more detail in Annex H.

29. Carbon Saving points, Affordable Warmth points, Carbon Saving Communities points and Rural Safeguard points are distinct currencies. Where an installation could generate more than one type of ECO point, energy suppliers choose which obligation the installation counts towards.

30. In the case of Affordable Warmth, only measures installed in an eligible group of low income vulnerable households living in private housing and identified through the benefits system would generate Affordable Warmth points to count towards the suppliers' obligations. Heating systems and the full range of energy efficiency measures are all eligible where they are assessed as reducing the notional cost of heating a property to an adequate internal temperature.

31. The "Carbon Saving obligation" target is intended to deliver energy efficiency measures into harder to treat properties. This is a key element of the policy that will drive up installation rates of these energy saving measures above the levels currently installed. This is necessary to unlock the large remaining potential in harder to treat buildings by driving economies of scale and encouraging innovation in the market, as the remaining installation potential from low

cost measures currently being installed shrinks - both in terms of absolute numbers of opportunities and the carbon savings that treating them will unlock. Solid wall insulation and insulating 'harder to treat' cavities will generate ECO carbon points, as will all thermal insulation measures that are packaged with them.

32. The "Carbon Saving Communities" (CSC) target, comprising 20% of the overall carbon target spend, is intended to deliver carbon saving measures to properties in low income areas and allows the full range of insulation measures to be delivered within defined areas. Modelling suggests that the creation of this target should increase the number of LI and CWI measures delivered, relative to the counterfactual, and overall carbon savings. It also drives greater bill savings for low income households. In theory, the creation of the CSC could result in a greater risk to the creation of the Green Deal market (because measures delivered in low-income areas are likely to require greater subsidy). However, at a level of 20% of the overall carbon target, the modelling suggests the creation of this obligation would have little impact on the demand for Green Deal finance. As such, this option was seen to meet the policy objectives and be consistent with the tenor of consultation responses.

33. The CSC obligation contains a "Rural Safeguard" target to ensure that rural households are not disadvantaged in this element of ECO. This sub-obligation will require suppliers to deliver at least 15% of their overall CSC obligation to household that are either in a rural area and in receipt of one of the AW qualifying benefits, or that are in a rural area which are also within or adjacent to a qualifying low income area. The eligibility criteria for the obligations are also contained in Annex H.

34. Government is working with ECO companies and other stakeholders to develop a brokerage system. Brokerage will be the subject of a further consultation in Summer 2012. The brokerage will enable Green Deal Providers to access the subsidy that is available for eligible measures by selling the ECO points that they will generate to energy suppliers. They will be able to pass through this subsidy to their customers to generate demand. In a competitive installation market the subsidy should all be passed through to householders.

35. The intention is for the policy framework to last for at least 10 years with targets set in phases. The first phase of the ECO will run with targets to be achieved by March 2015. The scheme will be monitored on an ongoing basis with a review in 2014 before the next phase of targets is set.

36. The ECO will complement the Green Deal, providing additional subsidy for measures which the Green Deal alone would not deliver. Complementary funding for measures alongside ECO subsidy could be available from other sources. However, this potential is not taken into account in this assessment.

37. There are measures which do not meet the Golden Rule but are part of a socially cost-effective strategy for meeting the UK's carbon targets, either because:
    - despite not meeting the Golden Rule they are socially cost-effective now. The Golden Rule does not take account fully of the expected rise in energy prices in real terms over the medium term nor does it factor in environmental externalities; or

- there are dynamic considerations in developing the best strategy for meeting the UK's long term targets. Investment now in deploying measures that are not currently socially cost-effective should drive down the cost of the measure for future periods through learning by doing and product innovation. There are also longer term benefits from reducing energy demand. A risk reduction or "hedging" strategy, which develops the foundation for deploying solid wall insulation (and other measures) at scale keeps the option open while more evidence is gathered on effectiveness and the best installation techniques.

38. Not all low income and vulnerable households will be able to finance measures through the Green Deal. Those with high actual energy consumption (low income, high use households) are likely to use sufficient energy for the bill savings from measures to be significant enough to be equal or greater than the repayments attached to a Green Deal package. A significant number of low income and vulnerable households are, however, likely to under-heat their homes and therefore be less likely to generate the bill savings from measures to be equal or greater than Green Deal repayments.

## Addressing Market Failures and Barriers

39. The combination of the Green Deal and the ECO will address a number of market failures and barriers to the take up of energy efficiency measures.

40. ECO will address **negative $CO_2$ externalities** by reducing demand for energy in two ways.
    - it will subsidise measures which are (or will be) socially cost-effective but that given the energy price are not privately cost-effective.
    - it will temporarily increase the price of domestic energy if, as expected, energy companies pass through the costs of offering ECO subsidies to energy consumers undertaking energy efficiency measures.

41. **Access to Capital.** Many households cannot access conventional finance markets to fund energy efficiency improvements, while other households and organisations may face high costs of capital that do not reflect the particular nature of energy efficiency investments i.e. a reliable stream of bill savings[26]. These households are credit constrained with their opportunity cost of investments in energy efficiency measures exceeding the social discount rate.

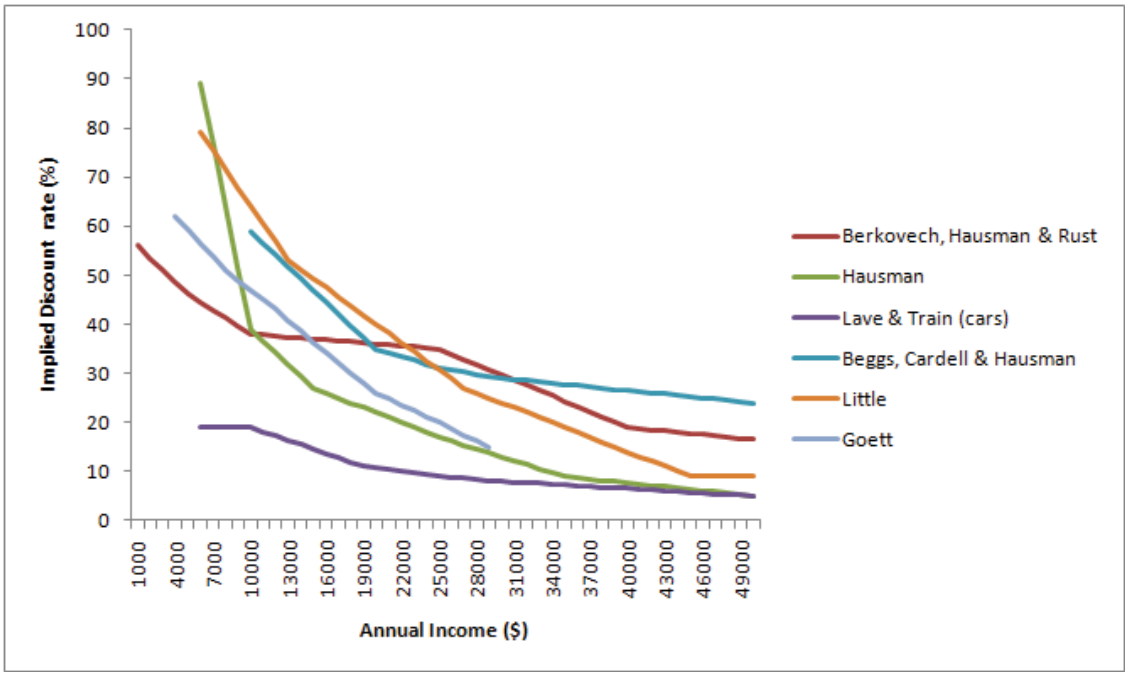
42. A substantial academic literature has developed on the topic of implied discount rates shown by consumers towards energy efficiency investments[27]. Many studies suggest that individuals demand a higher rate of return on energy efficiency investments than for alternative investments – an 'energy efficiency gap'. However, the studies have also shown that there is a strong negative relationship between income levels and the implied discount rates. Those with

[26] DECC's Green Deal Consumer Survey (2011) shows that the main reason people are prevented from making their homes more energy efficient is a lack of money(see Annex D).

[27] Such as: J. Hausman. "Individual discount rates and the purchase and utilization of energy-using Durables". The Bell Journal of Economics, 10(1):33-54, 1979 or A. Jaffe. "The energy-efficiency gap what does it mean?" Energy Policy, 22(10):804-810,October 1994.

lower incomes reveal higher implied discount rates and high earners reveal discount rates close to prevailing market interest rates. Figure 6, below, based on Train (1985)[28] summarises the relationship between income and discount rate found in a number of studies.

**Figure 6: Empirical estimates of the relationship between discount rates for energy efficiency investments and income (Train ,1985)**




43. Higher discount rates for those with lower incomes strongly suggest that at least part of the energy efficiency gap can be explained by credit constraints.

44. The Green Deal could significantly reduce the opportunity cost of capital for investments in energy efficiency, particularly for low income households for whom access to credit may otherwise be difficult or at least expensive (such as the high interest rates charged on credit cards). 52% of households currently have unsecured debts, 51% of whom find this debt a burden.[29] DECC's Green Deal Consumer Survey (2011)[30] found the main reason preventing households from investing in energy efficiency measures was lack of money (35% of respondents) and that groups with higher levels of interest in the Green Deal included those struggling to pay their bills, those on means benefits and those living in deprived areas.

45. Attaching the repayment charge to the electricity bill reduces the default risk for the finance provider relative to unsecured personal loans and should provide lower cost access to capital

[28] K. Train. Discount rates in consumers' energy-related decisions: A review of the literature. Energy, 10(12):1243-1253, December 1985.

[29] Source: *The financial position of British households: evidence from the 2010 NMG Consulting Survey,* Bank of England (www.bankofengland.co.uk/publications/quarterlybulletin/qb100408.pdf)

[30] See the Consumer Insight/Social Research – reference to be inserted.

for energy efficiency investments for lower income householders.[31] The domestic energy bill default rates are 1.5 to 2 per cent of gross revenue, compared with broader consumer credit costs of default which are significantly higher (see Annex I for more analysis). Paying utility bills and maintaining energy supplies to the home is a necessity and so payments will have one of the first calls on a householder's budget. The application of a conservative Golden Rule calculation methodology means that it is not expected for there to be a substantial impact on the default rate on energy bills as a result of households taking out a Green Deal.

46. **Information and Inertia**: The Green Deal addresses these problems via the accreditation of advisors and installers and providing trusted sources of energy efficiency services.[32] The Green Deal also creates a flexible market framework facilitating branded suppliers with existing customer relationships to come forward and market their services. The obligation on energy suppliers will drive the promotion of energy efficiency measures by suppliers and installers.

47. **Positive externalities.** Driving deployment at scale through the ECO obligation will drive learning by doing. This will reduce the cost of energy efficiency measures suitable for harder to treat home for future time periods.

48. **Misaligned incentives**. Tying the finance charge to the property rather than the individual will be attractive to some occupants. They will only be liable to pay the Green Deal charge while they remain in the property and continue to benefit from the measures that were installed. When leaving the property, the charge will pass to the new occupant and beneficiary. In the rented sector, landlords can install energy efficiency measures without paying the cost. Tenants would benefit from lower energy bills, and while they would be liable for the Green Deal charge, overall thanks to the Golden Rule they would be expected to have lower running costs.

49. **Time inconsistent discount rates**. The Green Deal and ECO change the time profile of the costs and benefits of energy efficiency investments. There would no longer be a large up-front financial cost and, either because of the Golden Rule or ECO subsidy, the investment would be expected to show a net benefit, or at least a neutral balance of benefits and costs, in all time periods. The change in how the energy efficiency investment is framed can increase take up.

50. The Green Deal and the ECO will also contribute to meeting the Government's **distributional objectives.** Improving energy efficiency means addressing one of the main drivers of fuel poverty in a way that has the most significant long run impact. Within ECO, the Affordable Warmth obligation will target thermal efficiency improvements at low income vulnerable private tenure households who are most at risk of fuel poverty. In addition, the Carbon Saving Communities obligation will target measures at households in low income areas who are also at risk of fuel poverty. Further, the Green Deal will increase the proportion of the cost of

[31] Indeed, findings from DECC's Green Deal Consumer Survey (2011) suggests that may be welcomed by certain specific groups of low income households. The survey found that interest in the Green Deal is particularly high among these households on low incomes (young, male) and those struggling to pay the bills in hard to heat homes (see Annex D).

[32] DECC's consumer research (2011) shows that people place great value on accredited advisors and installers with accreditation having a posiive impact on their likelihood to take up the Green Deal (see Annex D).

installing measures that is paid for by the beneficiaries. There will be less need for subsidy, paid for by all energy consumers on their bills, to drive the demand for energy efficiency measures.

51. The effectiveness of the Green Deal and ECO will not be determined solely by changes in the price of energy efficiency measures due to the available subsidy or reduced finance costs. The effectiveness of the policies will also reflect how the policies overcome the wider barriers which dampen the take up of energy efficiency measures. The analytical approach outlined in section 5 seeks to assess this full impact of the policies.

## 3.6 Alternative policy options

52. Alternative options to implementing the Green Deal and the ECO package were considered prior to the introduction of the primary legislation which created the parent powers for the secondary legislation. The UK Government must meet its statutory obligations under the Climate Change Act to reduce UK greenhouse gas emissions (GHG) and its statutory obligations to reduce fuel poverty. A viable alternative proposal must achieve deployment at scale of cost-effective energy efficiency measures - otherwise the costs to the UK of meeting carbon budgets would be substantially increased. It would also have to achieve improvements to the thermal efficiency of low income and vulnerable households to contribute to the Government's fuel poverty obligations.

### ECO Only

53. An alternative option where the Green Deal was not implemented but the objectives were met only through the ECO was considered. However, with no Green Deal mechanism, credit constraints associated with householders' investment in energy efficiency measures would not be alleviated. In addition, any self-finance of installation costs would be paid for by the individual rather than tied to the benefitting property and the subsidy would also have to rise to overcome other barriers that would have otherwise been addressed by the supply chain measures in the Green Deal. Because of these effects, there would be an increased role for ECO subsidy.

54. The proportion of the costs of installation of measures paid for by the beneficiaries of the measures would be reduced with greater pass through of (the higher) subsidy costs onto all energy consumers bills. This is a less desirable outcome, in terms of the distributional impacts of the policy, than where a higher proportion of the installation costs are paid for by the beneficiary. The impact could be partially offset through other aspects of the policy design (i.e. through ensuring that a greater proportion of measures were delivered to lower income households).

### Green Deal only

55. The option of implementing only the Green Deal was also considered. However, without partial upfront subsidy, many socially cost-effective energy efficiency measures would not meet the Golden Rule. Without the availability of partial subsidies, take up would be low, and below the level required to meet the UK's legally binding carbon budgets cost-effectively. If cost-effective energy efficiency measures are not deployed then other, less cost-effective abatement options would have to be used – increasing the overall cost to the UK of meeting

carbon budgets. Low income and vulnerable groups would also be less likely to benefit without the targeted support provided by the ECO, which would have an adverse impact on fuel poverty.

### Alternative Funding Mechanisms

56. Subsidies could be provided through a variety of mechanisms. The ECO is one of these, but in principle subsidies could be funded through general taxation, or could take a different form such as a stream of subsidy payments over the lifetime of the energy efficiency measure (i.e. an energy efficiency 'Feed-in-Tariff'). This stream of payments could again be paid for either through general taxation or through a levy on energy companies.

57. There are benefits to using the ECO to provide the required subsidy. Obligated suppliers in the energy market will face competitive pressures to ensure delivery of their obligation at least cost. SWI is a key pathway technology for the UK towards meeting its 2050 GHG reduction target. Through the ECO there is a strong signal of forthcoming demand for the supply chain to respond to – bringing forward investment from installers to increase their capacity and train additional installers. Through deployment at scale, the costs of SWI are expected to fall through 'learning by doing'.

58. Under the proposals in this impact assessment, the ECO achieves delivery of heating and energy efficiency measures to low income and vulnerable households through an Affordable Warmth obligation. After closure of Warm Front in 2013, ECO is the primary mechanism through which Government is delivering energy efficiency and heating measures to low income and vulnerable households in England. In comparison to delivering these measures through a tax-funded programme, the competitive pressures in the energy supply market provide an incentive to drive down the costs of installation. These pressures should allow for more low income and vulnerable households to benefit from measures for a given level of spend.

### Voluntary Approach

59. A voluntary approach working with energy companies would not provide the same confidence of future demand for solid wall insulation or that similar numbers of low income and vulnerable households would benefit from measures. Energy companies would not have an incentive, in the absence of the penalties for failing to meet their obligation, to provide upfront subsidy or promote solid wall insulation. Installers would have reduced confidence in future demand, slowing investment in the supply chain. This would in turn have a negative impact on carbon savings and addressing fuel poverty.

# 4. Background on Current Policies and Energy Efficiency Market

## 4.1 Current government policies

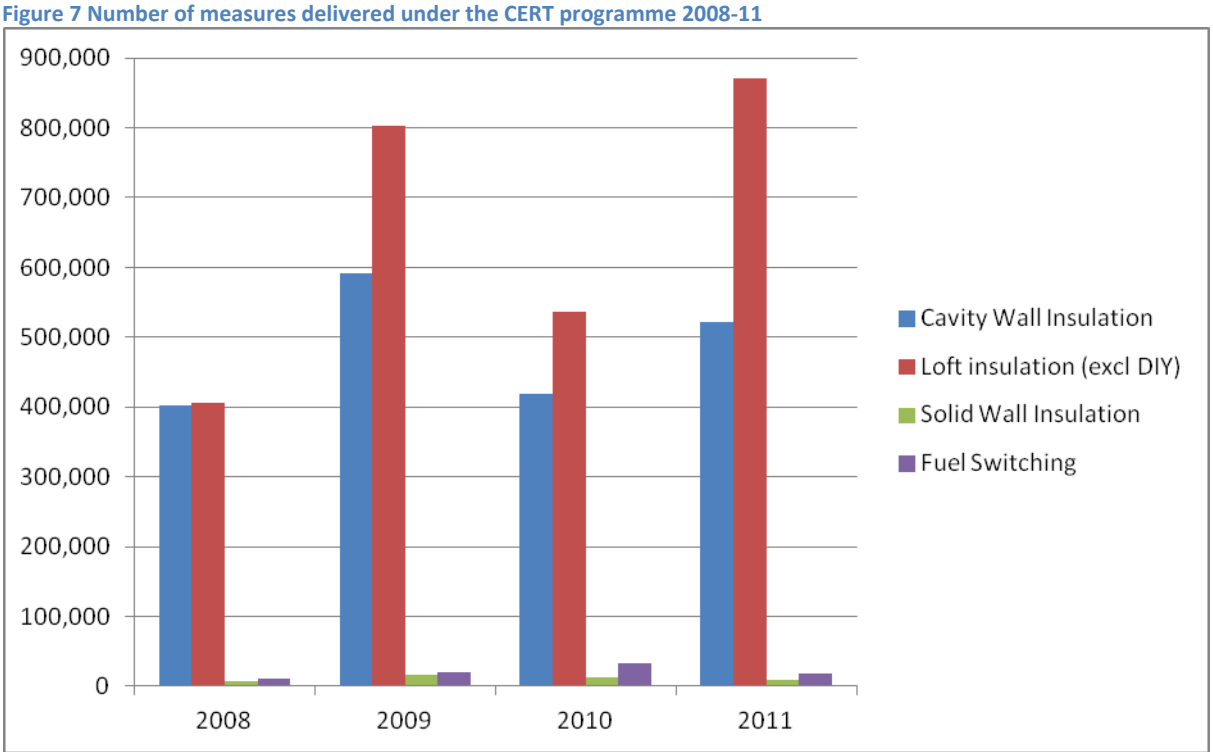
### Domestic Sector

60. In the domestic sector, the current major schemes to improve energy efficiency and support low income and vulnerable households to heat their homes will end within the next 12 months. The Carbon Emission Reduction Target (CERT) and Community Energy Savings Programme (CESP) end in December 2012, and Warm Front ends in March 2013. Warm Front, CERT and CESP have been responsible for substantially increasing the deployment of energy efficiency measures.

61. Under CERT, suppliers must promote (e.g. by marketing and/or through subsidy) measures to domestic energy users which can be proven to reduce households' carbon footprint through increased energy efficiency or reduced energy demand. Failure to meet the obligation would result in a large penalty. A minimum percentage of the carbon saving obligation have to be achieved in a priority group of vulnerable and low-income households, and within that a super priority group of households thought to be at greatest risk from fuel poverty[33]. Under the extension to CERT, at least 68% of the carbon savings must be achieved through professionally installed insulation measures. Suppliers are able to generate credit for carbon savings from DIY insulation by subsidising the sale of insulation materials through DIY outlets.

[33] More detail on the priority and super priority group can be found in the CERT extension IA: http://www.decc.gov.uk/assets/decc/consultations/certextension/121-iacertextension.pdf

Figure 7 Number of measures delivered under the CERT programme 2008-11




62. CESP[34] is a statutory carbon based obligation on energy suppliers and generators targeted at low income areas across GB. It is designed to deliver whole house retrofits on a street by street basis, particularly tackling hard to treat homes and especially incentivises the installation of more costly measures such as solid wall insulation. CESP, has the twin objectives of significantly reducing the fuel bills of some of those living in deprived areas and contributing to the improvement of the energy efficiency of the existing housing stock to reduce the UK's $CO_2$ emissions. The scheme is being run as a pilot (it is a relatively small scheme compared to CERT) and is intended to inform future household energy efficiency policy.

63. DECC has undertaken independent interim evaluations of CERT and CESP, which have provided part of the evidence base to inform the development of the ECO. The evaluations support the view that the policies are responsible for most of the take up of domestic insulation measures[35].

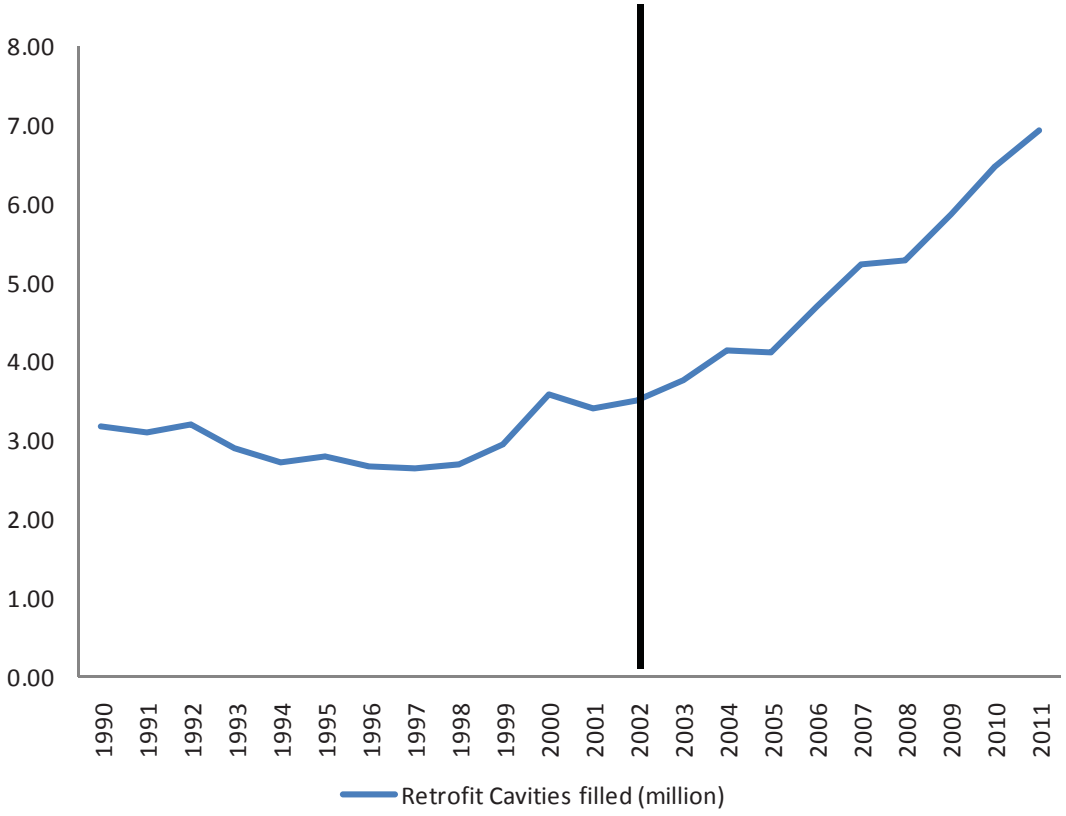
- Interviews with energy suppliers in the CERT/CESP evaluation[36] suggests that most of the major energy suppliers would not have delivered energy efficiency measures at all without CERT. Others felt they might have done so on a smaller scale.

[34] http://www.decc.gov.uk/en/content/cms/consultations/open/cesp/cesp.aspx
[35] Evaluation synthesis of energy supplier obligation policies, DECC, 2011, http://www.decc.gov.uk/assets/decc/11/funding-support/3340-evaluation-synthesis-of-energy-supplier-obligation.pdf
[36] Evaluation synthesis of energy supplier obligation policies, DECC, 2011, http://www.decc.gov.uk/assets/decc/11/funding-support/3340-evaluation-synthesis-of-energy-supplier-obligation.pdf

- The research suggests that CERT has successfully driven cost-effective delivery of relatively low-cost energy efficiency measures (especially loft and cavity wall insulation) and led to increased capacity in the supply chain.
- There was consensus amongst delivery stakeholders that the CERT subsidy from energy suppliers was highly significant in driving the market for loft and cavity wall insulation, with an expectation amongst many consumers for free or cheap measures. Consequently, there was an associated concern amongst delivery stakeholders that demand for these measures would decrease drastically in response to a change or stopping the policy. The ECO and Green deal should minimise the negative impact of the transition from CERT. Details of this analysis is presented in Annex H.

64. In the counterfactual to the Green Deal and the ECO used for this impact assessment, CERT and CESP finish and there is no further policy intervention. This counterfactual is developed in section 6 below. Without further policy intervention, the installation rate of domestic insulation measures are projected to collapse. Data on the number of filled retrofit cavities show a marked increase following the introduction of large scale obligations on energy suppliers in 2002.

**Figure 8: Number of retrofit cavities filled**[37]




[37] Source: Department of Energy and Climate Change

### Non-Domestic Sector

65. The Green Deal market will cover the domestic and the non-domestic sector, whilst ECO subsidy will only be available for the domestic sector. For the purpose of this assessment, separate models for the domestic and non-domestic sectors are used (see section 5).

66. In the non-domestic sector, the current major schemes to improve the energy efficiency of the non-domestic building stock, such as the Carbon Reduction Commitment energy efficiency scheme, would continue after the start date for the Green Deal. However these non-domestic schemes have incomplete coverage and incompletely address barriers and market failures which reduce take-up of cost-effective energy efficiency measures in the non-domestic sector.

### Policies covering domestic and non-domestic sectors

67. In addition to overarching policies targeting energy efficiency, for both the domestic and non-domestic sectors there are a number of policies that covers both sectors that must be accounted for when considering the impact of the Green Deal and the ECO policy package. Such policies include the roll-out of smart meters, building regulations, products policy (including mandatory minimum standards of energy efficiency for energy using products), energy taxation (such as the Climate Change Levy), the Renewable Heat Incentive and Feed in Tariffs. These policies can target the same energy efficiency measures as the Green Deal and the ECO, reduce demand for energy services or reduce the carbon intensity of energy supply thereby reducing emissions savings from energy efficiency measures. These policies are accounted for in the generation of the counterfactual (see section 6). Policies may also work together with the Green Deal to drive take up of measures if the Green Deal is used to finance energy efficiency measures that would have otherwise been financed using another route. There may also be synergies for the Green Deal when awareness of these other policies is raised.

## 4.2 Domestic building energy efficiency market

68. The market for energy efficiency measures in the domestic residential sector has been boosted by the supplier-led policies (highlighted above). The overall market size in 2007 was estimated at £8.25bn[38], mainly attributable to double glazing, insulation, boiler replacement and wet appliances. Heat controls, efficient lighting and micro-generation accounted for the smallest share. Figures from 2009 to 2011 on some sub-sectors of this market are presented in the table, below.

**Table 4: Market size of domestic energy efficiency measures**

| Measure | Market Size (£bn)[1] | Installations p.a. | Year |
|---|---|---|---|

[38] Source: *Assessment of the Size of the UK Household Energy Efficiency Market*; Element Energy Ltd and Quantum Strategy & Technology Ltd; November 2008

[1] Source: AMA research (www.amaresearch.co.uk, reports of various dates) and *Assessment of the Size of the UK Household Energy Efficiency Market*; Element Energy Ltd and Quantum Strategy & Technology Ltd; November 2008. The methodologies used in these two studies are different.

| | | | |
|---|---|---|---|
| **Lighting** | 0.6 | 81.6m | 2010 |
| **Space and Water Heating** | 0.7 | 1.5m | 2010 |
| **Doors and Windows** | 1.9 | 3.7m | 2009 |
| **Ventilation and Air Conditioning** | 0.9 | 1.5m | 2009 |
| **Heat Pumps** | 0.07 | 6,700 | 2010 |
| **Insulation** | £0.7bn[2] | 1.6m[3] | 2010/2011 |
| **Solar Thermal** | n/a | 20,000 | 2010 |
| **Biomass** | n/a | 2,060 | 2010 |
| **Draught Proofing** | n/a | 26,000 | 2010 |
| | | | |

69. Within the insulation market, the majority of work is in filling lofts and cavity walls, which was the main focus of energy suppliers in order to comply with the CERT-related measures. There were around 870,000 lofts (excluding DIY), 520,000 cavity walls and 10,000 solid walls insulated during 2011 under CERT. This compares to around 540,000 lofts (excluding DIY), 420,000 cavities and 13,000 solid walls over the preceding year under CERT.

70. The market is estimated to support around 75,000 manufacturing jobs[38], the majority of which are in the manufacture of glass and double glazed windows and doors, not traditionally associated with the insulation market. For the insulation market, it is difficult to assess the number of jobs supported because many energy efficiency measures may be installed as part of larger renovation or extension projects. A particular proportion of domestic construction jobs cannot easily be attributed to energy efficiency. Specialist construction skills are not required to install windows and energy efficient boilers typically have the same installation process as inefficient ones. Estimates suggest around 4,700 installers[39] were employed in the insulation market in 2007/8, which covers loft and wall insulation, and another 22,000 are employed in the wider supply chain.

## Financing of measures

[2] This market size includes measures delivered under CERT, CESP, warm front, in new build properties and the DIY market.
[3] Source: Statistical release: Estimates of home insulation levels in Great Britain - October 2011 (http://www.decc.gov.uk/assets/decc/11/stats/energy/energy-efficiency/3780-stat-release-home-insulation-oct11.pdf)
[39] Source: *Low Carbon and Environmental Goods and Services: an Industry Analysis*; Innovas; 2009

71. The modelling of Green Deal finance assumes everyone accepting SWI, CWI or LI following a Green Deal assessment uses Green Deal finance to pay for it. Clearly there are uncertainties around this as different people will have different payment options available to them; some may choose to pay up-front and others may prefer alternative forms of finance.

72. The central reason for our assumption is that the choice experiment on which Green Deal finance volumes are based should filter out people who choose to pay via other methods. This is because the details of the Green Deal were fully explained to respondents prior to their decision on whether to take out a plan. So when they accepted they should have been making a decision not just on whether to take a measure but also on whether to use the Green Deal rather than other payment methods.

73. To reflect the uncertainty though, we also model high and low scenarios. The low scenario reflects the fact that a quarter of those who accepted a Green Deal also expressed a preference for paying up-front in a separate question. In addition, evidence from the current market for energy efficiency and home improvement products suggests paying up-front may be a favoured option for a proportion of people, particularly when the (post-subsidy) cost of the product is small[40]. To reflect this, the low finance scenario assumes that 50% of easy to treat CWI (the cheapest measure predicted to generate significant levels of finance) is paid for up-front rather than using Green Deal finance.

74. The high scenario reflects the fact that if people are willing to pay for measures up-front once they fully understand the long term benefits, some other modelling assumptions look very conservative. For example, the model automatically strips out households that don't meet the Golden Rule[41] but if some consumers are prepared to pay a proportion of costs up-front this would unlock more opportunities for Green Deal finance. This could be particularly true for packages including measures – like boilers – for which customers are used to paying an up-front cost. Business models provided by key providers predict far higher levels of Green Deal finance from these types of packages than is projected by the GDHM. Hence our high scenario doubles the number of boiler upgrades that use Green Deal finance to reflect this (see Annex B for more).

## 4.3 Non-domestic building energy efficiency market

[40] A DECC survey found that 13% of those who bought an energy efficiency or home improvement product in the past 12 months paid using finance with most saying they paid up-front. Asked to consider a hypothetical (non-GD) purchase of £500, only 9% said they would use finance. This rose to 30% when the cost was £5,000. These results are broadly consistent with other UK and US evidence, see http://www.oft.gov.uk/shared_oft/reports/consumer_credit/oft1150.pdf and http://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/n03-1_martin.pdf. It is important to note then, that the survey in which the GD was fully explained resulted in a far higher proportion of people (75%) expressing a preference for (GD) finance than in the current market. This reflects the impact that the GD could have. Indeed, a strong reason why people may be rejecting finance options currently is that, as an Energy Saving Trust report concluded: ""there is no significant loan infrastructure in the UK targeted on financing carbon saving measures."

[41] Given the repayment periods assumed in the model.

75. It is difficult to assess the current size of the non-domestic buildings' energy efficiency market because there are no delivery policies from which installation statistics are available. However, there are known trigger points where energy efficiency measures are taken up, or when the market is more likely to take steps to improve their premises' energy efficiency. These trigger points are:

- Breaks in tenancy agreements;
- Consequential improvements: the 2010 Building Regulations state that if a property over 1000m$^2$ is being extended, or a fixed building service is being installed or its capacity increased , then the energy efficiency of the rest of the property must be brought in line with the current Building Regulations standards (consequential improvements). This creates a market for energy efficiency improvements on the existing building stock; and
- Major refurbishment: buildings undergo a major refurbishment every 25 years or so[42].

76. There are organisations whose core business covers delivering energy efficiency measures into non-domestic buildings while guaranteeing costs or energy savings. These include energy service companies (ESCOs), those delivering energy performance contracts and guaranteed energy savings.

## Financing of measures

77. The methods of financing energy efficiency measures will depend on a number of factors, such as their size and sector. The choices available include the following:

- self-financed from cash reserves;
- financed through existing borrowing channels; or
- financed through a new borrowing channel, often introduced or arranged via an ESCO.

78. For organisations that invest in energy efficiency measures, they are most commonly financed through organisations' cash reserves[43], as they are often viewed as low risk, high return investments. Larger organisations will typically have more ready access to finance, either from cash reserves or borrowing, and have greater competencies in the area of financing capital projects, than smaller organisations. This market will also attract ESCOs, who concentrate on projects sufficiently large to achieve economies of scale. For smaller organisations, financing projects outside their core business area is more challenging and they are also less able to attract ESCO-type organisations' business because of their size.

79. Many large retail organisations self-fund energy efficiency measures because of their strong cash position and are more engaged in energy efficiency than smaller retailers.

80. The UK's large commercial office market is less engaged in energy efficiency than in some markets, such as Australia, where landlords compete to make their buildings more energy

[42] Duration recommended by the Department of Communities and Local Government
[43] Steven Fawkes, DECC adviser; and DECC's non-domestic Green Deal Business survey, which showed that 65% of respondents with responsibility for energy efficiency would use cash to pay for energy efficiency improvements.

efficient than their competitors'. There is also little ESCO activity in this market because of the split incentives between tenants and landlords. Nevertheless, some landlords are starting to see the value in making their buildings' common areas more energy efficient. These projects are typically self-financed. There are also emerging models to address the split incentives barrier, such as Green Leases, and managed energy service agreements where tenants sign up to energy management contracts that benefit them and are financed by them.

81. More energy intensive organisations, such as IT data centres and industrial plants, are more engaged in energy efficiency because energy makes up much more of their operating costs. Being core to their business means that many of these measures are self-financed but, owing to their complexity, they have a limited attraction for external finance providers.

# 5. Analytical Approach

82. To estimate the impact of the Green Deal and the ECO, the projected take up of energy efficiency and heating measures with the policies acting is compared to the projected take up if the policies were not introduced. Three models have been used. In the domestic sector, the Green Deal Household Model (GDHM) has been used to model the carbon target element of the ECO and the introduction of the Green Deal mechanism in the domestic sector. The GDHM is not an appropriate tool to optimise the Rural Safeguard element of the ECO. Therefore, whilst the overarching CSC target and the CSO target is set by modelling optimisation, the Rural Safeguard target has been estimated by pro-rating 15% of the overall Carbon Saving Communities carbon target. The Affordable Warmth target has been modelled separately. Finally, a third model has been used to estimate the take up of energy efficiency measures in the non-domestic sector because of the Green Deal. Each of these models is described in turn.

## 5.1. The Green Deal Household Model

83. The ability of models to fully capture the likely uptake of measures is limited, given the innovative and open market characteristics of the Green Deal and ECO policy framework. The Green Deal will enable the development of new business models and delivery systems, therefore predicting the uptake of Green Deals in the market is inherently difficult (see section 7.1 for detailed discussion).

84. The Green Deal Household Model (GDHM) provides projections for the take up of the three most significant domestic insulation measures – loft, cavity and solid wall insulation. These measures are projected to deliver the overwhelming majority of the carbon savings to meet the ECO's carbon target. Other eligible measures have also been assessed and linked to the GDHM to provide a more comprehensive projection of take up of measures under the Green Deal and the extent to which measures packaged with wall insulation will generate ECO points.

### Domestic sector technical potential

85. Table 5 presents the remaining technical potential for energy efficiency improvements in domestic sector buildings. These estimate are based on results from the English House Condition Survey[44], adjusted to account for the impact of existing government policies which will be operating until December 2012. The potential market size represented by this remaining potential is vast; the total capital cost of all the remaining technical potential in 2013 is estimated to be £58bn, of which low cost cavity wall and loft insulation makes up only £2.2bn.

**Table 5: Domestic sector technical potential**

| | Technical potential |
|---|---|
| Solid Wall insulation | 6.9m |

[44] Reference to be inserted

| | |
|---|---|
| Cavity wall insulation – easy to treat | 2.6m |
| Cavity wall insulation – hard to treat | 3.2m |
| Top-up loft insulation | 5.7m (of which 0.2m virgin loft) |
| Floor insulation | 3.0m |
| Non-condensing gas boiler to condensing gas boiler | Roughly 12m non-condensing boilers remain in UK housing stock |
| Glazing | 2m[45] single glazed properties |

86. The assessment of the potential for measures to be part of a Green Deal finance package, or to be part of a package of measures generating ECO points is provided in Annex B. The assessment considers a range of factors, including past sales, the level of energy savings the measures achieve, the proportion of the cost of installation that can be Green Deal financed and the level of ECO subsidy they attract when installed alongside solid wall or hard to treat cavity wall insulation. In a number of cases, in particular for innovative measures, there is uncertainty over the effectiveness of measures and how their costs will evolve. Projections for these measures are particularly uncertain, but the Green Deal will include flexible systems that will enable and encourage the development of new energy efficiency products.

### Cost effectiveness of technical potential

87. The marginal abatement cost curves (MACCs), below, show the cost-effectiveness of the major insulation measures in 2013 and 2020. Using a static comparison, around 3.8 $MtCO_2e$ is cost effective[46] in 2013. By 2020, this is expected to have increased to around 4.5 $MtCO_2e$ as a consequence of falling installation costs owing to learning and economies of scale, the expected increase in fossil fuel prices and higher cost of a tonne of $CO_2$ (shown in dashes).

88. The MACCs show that the most cost effective insulation measure in both 2013 and 2020 is easy to treat cavity wall insulation. They also show that the cost effectiveness of solid wall insulation varies substantially depending on the house type it is being installed in and whether the insulation is applied internally or externally. Under the ECO, suppliers would seek to minimise their costs of meeting their obligation which would largely be determined by the subsidy to householders. It could be expected that to drive demand for measures, the subsidy per $tCO_2$ saved would be lower for more cost-effective solid wall insulation measures, ensuring that the ECO would drive the installation of the more cost-effective opportunities. A static comparison to DECC/HMG carbon values, particularly in 2013, shows that a substantial proportion of the Solid Wall insulation potential is cost-ineffective.

89. The static comparison of cost-effectiveness should be complemented by dynamic considerations and awareness of how the cost-effective benchmarks for Government appraisal

[45] England only – to be updated

[46] Cost effectiveness defined as being at or below the non-traded cost of carbon of £57/$tCO_2$ in 2013 and £63/$tCO_2$ in 2020. See Table 18 in Annex A for more information.

were generated. The policy package could be expected to improve the cost-effectiveness of solid wall insulation in future time periods through learning by doing and induced innovation (see section 4.1.4). The MACCs shown in Figure 12 and Figure 13 show that by 2020 more solid wall insulation is cost-effective – this is partly a result of an assumption of higher energy prices in 2020, but also reductions in the cost of solid wall insulation over time.

90. In addition, the carbon values were derived using a target-consistent approach in 2009. This target-consistent approach used MACCs developed by the Committee on Climate Change to estimate the marginal cost of meeting the UK's carbon budgets. The MACCs included a substantial abatement potential from Solid Wall Insulation which was below the marginal cost. Updating our view of the cost-effectiveness of SWI, increasing the cost per tonne, would increase the estimate of the marginal cost of meeting carbon budgets were the target-consistent analysis revisited. The relative cost-effectiveness of SWI should also be considered with respect to the latest evidence on the cost-effectiveness of other abatement measures across the economy.

**Figure 9: Marginal abatement cost curve for domestic sector insulation measures: 2013**

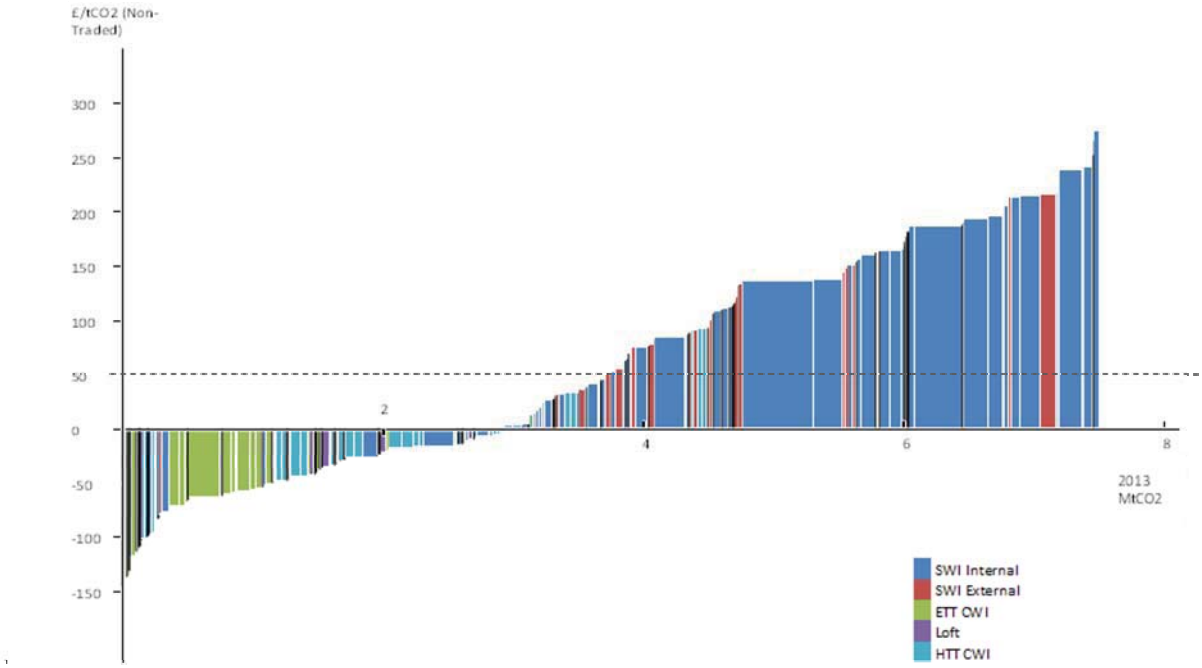
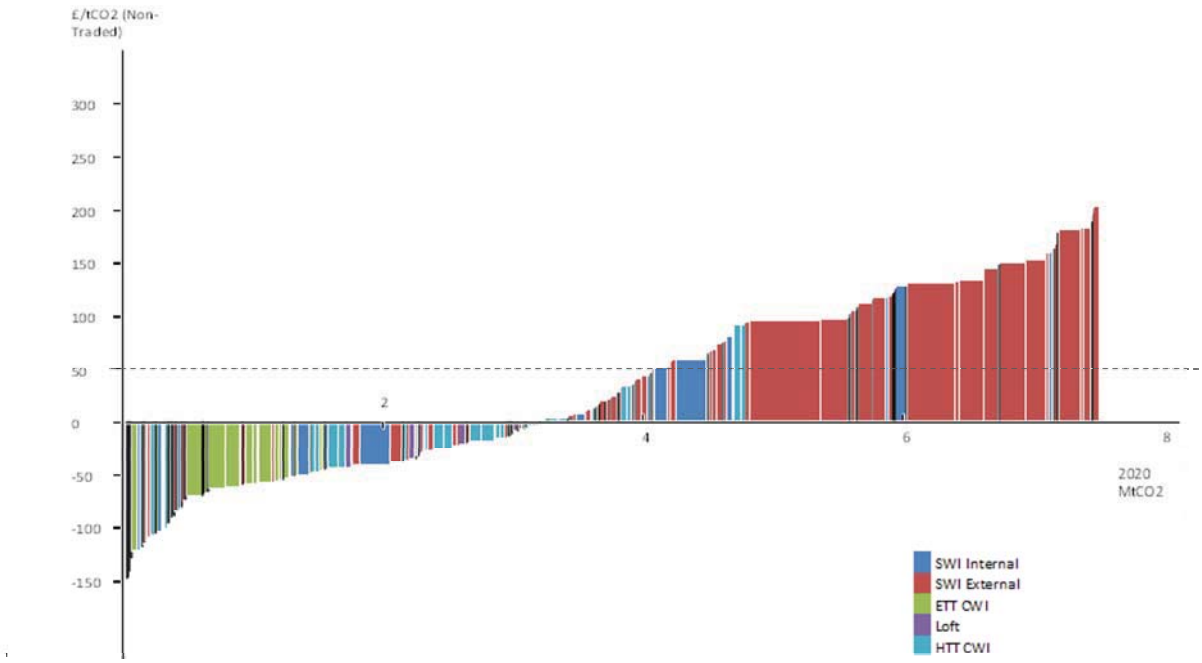



**Figure 10: Marginal abatement cost curve for domestic sector insulation measures: 2020**



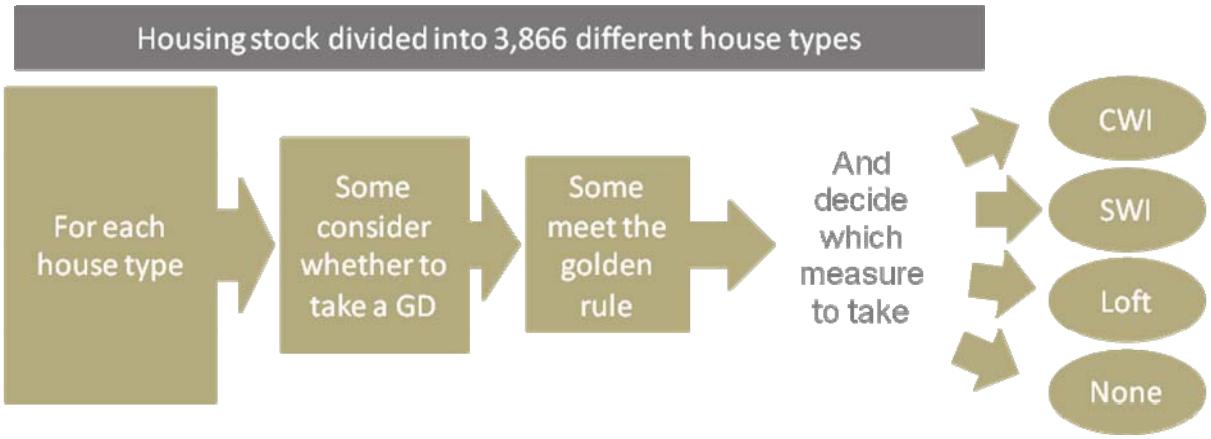

## Estimating uptake of domestic insulation measures

91. The GDHM is a housing stock model that simulates the uptake of energy efficiency measure each year. The steps are:

- The British housing stock is divided into 3,866 house types which reflect permutations of size, heating fuel, tenure and existing level of loft and wall insulation.[47]
- The characteristics of the different properties determine which measure they are eligible for and what the costs and energy savings would be.
- Each year a certain number of households consider taking out a Green Deal.
- The GDHM uses consumer preferences derived from the Green Deal survey to estimate the probability that each of these household takes up a measure.
- Only measures that meet the golden rule without any additional or upfront payment by the consumer are taken up.
- The probability of uptake is determined by the net bill savings (bill saving minus repayments), the level of upfront capital and assessment cost, the length of the Green Deal plan and the type of measure offered. The net bill savings are determined by energy prices, cost of measures, the interest rate of the Green Deal plan and the amount of ECO subsidy available.
- The probability that a house type will take up a measure is multiplied by the stock of houses it represents to provide an estimate of total uptake.

[47] Based on English, Scottish and Welsh house condition surveys.

Figure 11: Modelling take up in the Green Deal Household Model




92. The consumer preferences incorporate the additional 'hidden' costs associated with energy efficiency measures, such as the hassle cost of householders having to spend time working with Green Deal assessor and installers. Green Deal survey participants were also given a description of the key elements of the Green Deal Mechanism (energy efficiency measures would be installed at no upfront cost and repayments would be attached to the properties energy meter). The consumer preference therefore also reflect consumer attitude to the new finance mechanism, at the point at which the survey was carried out.

93. The analysis is based on the assumption that energy companies optimise their subsidy spending to meet their carbon target obligation at lowest cost, and that the total costs passed through to consumers is based on the marginal subsidy cost of the last measure required to meet the target multiplied by the size of the obligation (see section 9 for further details). The input assumptions are fully set out in Annex A and a more detailed explanation of how the model works is provided in Annex B.

Box 1: Estimating Green Deal demand from consumer surveys

The domestic sector uptake estimates presented in this impact assessment are based on the Green Deal consumer survey. This was a survey of 2,023 homeowners and private tenants in Great Britain which explored the impact of different aspect of the Green deal offer on consumer demand. The Green Deal is a market-based mechanism: market participants will drive product and service innovation, marketing, packaging and cross-selling. This environment is impossible to replicate in a research environment and so estimated demand figures must be seen within this context.

Respondents were asked to make a choice between a number of Green Deal packages with varying attributes, such as the type of energy efficiency measure, the cost of an assessment or the net savings. Respondents traded off these attributes against each other, and indicated their preference. This information was used by Element Energy and Cambridge Architectural Research to estimate the probability that an individual household would take up a Green Deal, and how this varied depending on the package offered.

The survey respondents were provided with a detailed explanation of the consumer journey that covered the accredited assessment, accredited installation, the different measures available and how the new finance mechanism would work. The consumer behaviour in the GDHM is based on the results of the choice experiment within the Green Deal consumer survey. It therefore reflects not

only the financial benefits of the packages of measures but also consumers' perceptions of hidden costs, preferences for particular measures and attitudes to the finance mechanism itself.

There is inherently a degree of uncertainty involved when using a stated preference survey to estimate demand from the population as a whole. The results of the model have therefore been compared against evidence from the evaluation of existing pilots and trials. These show that the demand estimates are broadly consistent with what has been observed in practice.

## 5.2. The Affordable Warmth Model

94. The Affordable Warmth obligation is modelled separately from the ECO carbon target, although there are some interactions between the Green Deal and Affordable Warmth models.

95. Information about the number of opportunities to install new heating systems and low-cost (i.e., loft and cavity-wall) insulation within the Affordable Warmth eligible group is based on data from the English Housing Survey, Scottish House Condition Survey and Living in Wales Survey. The stock of insulation in the Affordable Warmth model is adjusted downwards to reflect number of insulation measures that are assumed to be installed through the Green Deal carbon obligation. The *flow* of replacement heating systems within the Affordable Warmth eligible group is based on assumptions about the rate of breakdown of boilers. It is assumed that a standard boiler has a lifetime of 12 years - it can therefore reasonably and conservatively be expected that the one in fourteen boilers within the eligible group breakdown each year. This information is combined with data on: (1) SAP-based information on the impact that heating and insulation measures will have on notional energy bills; and (2) the delivery cost of different measures, in order to construct a supply curve for Affordable Warmth compliance.

96. The modelling assumes that suppliers and installers will, where possible, deliver packages of measures whilst they have access to a property. For example, whilst a new heating system is being installed in a dwelling with no loft insulation, then it is assumed that both measures will be installed. As such the supply curve ranks all heating and insulation *packages* in cost effective order. This is a departure from the methodology in the consultation impact assessment where it was assumed that measures would be delivered in a strict order of cost effectiveness (i.e., where a particular dwelling had a number of opportunities to install measures, an energy supplier will only install the most cost effective measures within that package). Naturally, this lowers the overall NPV of the policy (as fewer of the most cost-effective measures are delivered). However, it is believed that this is a better approximation of actual delivery patterns. The supply curve is recalculated each year as measures are installed in the modelling.

97. A full description of the Affordable Warmth model, including all of the underlying assumptions, are provided in Annex D.

## 5.3. Non-domestic Sector Model

98. Two modelling tools have been adopted in the non-domestic sector to analyse the impacts of the Green Deal and the potential savings from supporting policy in the Private Rented Sector (PRS) respectively. More comprehensive details on the modelling undertaken in the non-domestic sector may be found in Annex C.

99. For the voluntary aspect of the Green Deal, a stock of energy efficiency opportunities has been identified using information from the Non-Domestic Buildings Energy and Emissions Model (N-DEEM). This has been supplemented with insights on possible options for bundles of Green Deal measures that can be installed in specific building types. This additional information has been adapted from work undertaken by the Carbon Trust/AEA as described in Annex C. The take-up of these bundles is assessed based on a consideration of the decision-making process that a potential Green Deal consumer might go through based on evidence from the Green Deal Business Survey[48]. Combining the decision-making analysis with the stock of energy-efficiency measures available in the cross-section of non-domestic buildings, it is possible to obtain projections of the take-up as a result of the Green Deal.

100. The impact of supporting policy in the private rental sector (PRS) has been assessed in the context of lifting all buildings with an F or G- rating on their Energy Performance Certificate (EPC) to an E-rating, whilst accounting for the barriers that may prevent this being universally applied. The Carbon Trust's analysis[49] forms the basis of the assessment of these impacts. The analysis has been extended by considering the take-up as a result of existing policy (to avoid double-counting), and the proportion of this potential that would not be deliverable, be it as a result of exemptions or other limiting factors. The take-up profile has been linked to the distribution of lease periods in the PRS. This approach assumes that the signing of new leases forms the primary determinant of when measures are installed.

101. In order to estimate the number of Green Deal packages taken out, an estimate of the average size of a Green Deal is estimated. This uses data on the number of premises likely to be EPC rated F or G in the PRS, along with the capital values estimated from the PRS estimates, above. Based on expected annual take up rates , this gives an average size of Green Deal in the PRS sector, which is then applied to the other areas of the sector that take out Green Deal packages.

[48] The Green Deal Business Survey will be published alongside the Government Response. http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx

[49] Presented in the report "Building the Future Today" http://www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTC766

# 6. Counterfactual

## 6.1 Domestic counterfactual

102. Estimating the likely impact of the Green Deal and Energy Company Obligation (ECO) requires an assessment of what would occur in the absence of the policies. This counterfactual or Business As Usual (BAU) scenario forms the starting point for analysis of the impacts. There are a number of factors that would affect the uptake of measure in the absence of the policy package. The BAU take-up of energy efficiency opportunities is driven by:

- policy that would be present in the absence of the Green Deal and ECO;
- potential remaining after the impacts of current energy efficiency policies (CERT and CESP) ending in 2012
- behaviour trends and changes in awareness;
- technological progress, with new energy efficiency products available, and changing costs of measures; and
- energy prices, which are expected to rise over the period in real terms.

103. Sales of domestic sector energy efficiency measures in the counterfactual are projected to be much lower than historic sales. For the past decade the market has been driven by high levels of subsidy provided through the CERT, CESP and EEC policy interventions. By comparison, the BAU scenario is based on a market in which these policies end, and no further policies are implemented to replace them. CWI sales between 1990 and 2002 (when EEC was introduced) averaged around 200,000 per year[50] (of which around 180,000 were new build)[51]. Uptake in the BAU may be higher than this given real energy prices have since risen 2002. On the other hand there is now considerably less potential for CWI within the housing stock. 67% of all cavities will have been insulated by 2013 and 58% of the remaining potential is hard to treat or untreatable, which are unlikely to be insulated without government intervention. There is less data on uptake of SWI. Known uptake during 2011 was around 22,000, driven by CERT and CESP.

104. The GDHM has been used to project forwards the counterfactual for these measures assuming there is no marketing by energy companies or Green deal providers and consumers receive no subsidy. The details of this scenario are set out in annex B and the result are summarised in Table 4. The table also shows historic uptake rates for SWI, CWI and LI to illustrate the impact of current policy (CERT and CESP). The analysis of the counterfactual also included an adjustment to consumer demand to account for the lower levels of marketing and other sales activity that would result from the Green Deal not being implemented. Our modelling assumes that the number of boilers installed under the Green Deal and ECO framework is the same as it would be in BAU, but that some of these are now paid for using

[50] *Energy consumption in the UK:2011, table 3.15b*
[51] CLG House Building statistics: http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/housebuilding/livetables/

Green Deal finance. In other words, relative to the counterfactual, we assume the policy framework does not generate additional uptake of these measures, but does generate additional Green Deal finance. This is set out in annex B.

**Table 6: BAU take up of major insulation measures**

| | Annual average uptake in BAU (no existing or new policy) | Annual uptake to April 2011 (existing policy)[52] |
|---|---|---|
| SWI | 700 | 22,000[53] |
| CWI | 42,000 | 590,000 |
| LI (virgin and top-up) | 21,000 | 1,000,000 |
| Draft proofing and glazing (packaged with wall insulation) | 3,200 | No Data Available |
| Floor insulation (packaged with wall insulation) | 100 | No Data Available |

105. The modelling on the Affordable Warmth obligation is expected to deliver predominantly new and replacement heating systems and insulation measures. Measures are targeted at low-income households (in receipt of certain 'passport benefits'[54]) in private housing tenures. The heating and insulation measures that will be delivered will require significant capital outlays and it is assumed that this is beyond the means of households within the target group. As such, it is assumed that the measures delivered by the obligation are 100% additional.

## 6.2 Non-domestic counterfactual

106. Business-as-usual take-up rates will depend on the abatement opportunities, underlying market-driven take-up, and the effect of other policy interventions.

107. The remaining abatement opportunities in the current building stock is modelled to give an estimate take-up of the potential stock of energy efficiency opportunities (see Figure 12 and Figure 13, below). The methodology for this is described in more detail in Annex E. The BAU take-up of opportunities are accounted for in two steps: first, account is taken of the take-up achieved under a pre-Energy White Paper (EWP) 2007[55] policy mix; and second adjustments are made for policy that has been implemented since then (see Annex C for details of how this is modelled). This delivers an estimate of the remaining energy efficiency potential of 19TWh between 2013 and 2022, a proportion of which could potentially be delivered by the Green Deal.

[52] No data available on uptake of draft proofing and glazing package with wall insulation.
[53] Figures for the full calendar year of 2011.
[54] A means tested state benefit, such as Pension Credit. Receipt of certain passport benefits make a household eligible for support under the Affordable Warmth target.
[55] http://www.decc.gov.uk/en/content/cms/legislation/white_papers/white_paper_07/white_paper_07.aspx

Figure 12: Non-Domestic Sector's Potential Energy Savings

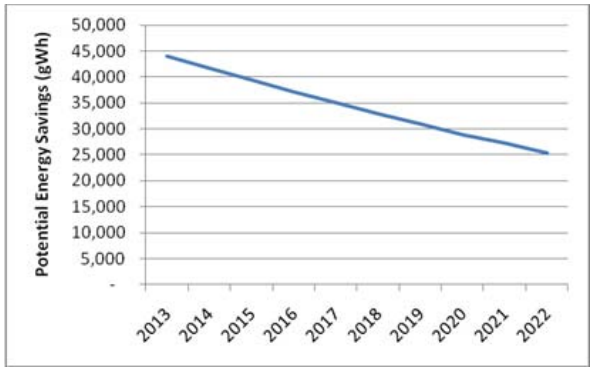
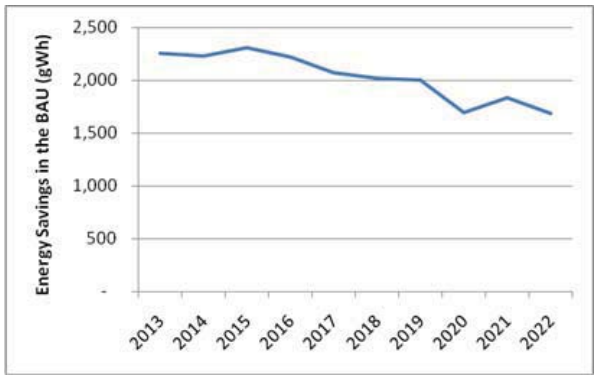



Figure 13: Non-Domestic Sector's Business As Usual Abatement



# 7. Aggregate Impacts

108. This section sets out the aggregate impacts of the Green Deal and ECO policy package. It covers the high-level costs and benefits of the policy, the uptake of energy efficiency measures, the carbon and energy savings delivered and the distribution of the impacts across different section of society. The central scenario set out below reflects the best estimate given current evidence.

109. There is a high level of uncertainty around the estimates presented in this section. A number of the key drivers of outcomes, such as energy prices and consumer demand for the Green Deal, are difficult to predict. The projections of uptake are primarily based on a consumer survey of 2,023 respondents and the housing stock data is based on a survey of 16,150 properties. These have been used to estimate the impact of the policy package on 26m households in GB, which inherently leads to considerable uncertainty in the results. The Green Deal is a market based mechanism, and while the ECO targets provide some certainty around the amount of carbon delivered by that policy, it is very difficult to predict how the Green Deal market will develop before the policy framework becomes operational. We have therefore conducted an extensive sensitivity analysis to illustrate the range of possible outcomes under different assumptions. The sensitivity analysis has been used to develop a high and low estimate of the impact of the policy package (see section 7.5).

110. The central estimates for the high-level aggregate impact of the Green Deal and ECO are set out in Table 7. The total benefits of the policy are estimated at £25.6bn, compared to a total cost of £17.3bn. The majority of the costs are made up of installation costs (58%) and hidden costs (20%) whilst the majority of the benefits are from energy savings (59%).

**Table 7: Aggregate Impacts (£m, unless otherwise stated)**

| | Low scenario | Central scenario | High scenario |
|---|---|---|---|
| Installation costs | £9,088 | £10,121 | £10,580 |
| Additional costs | £3,005 | £3,468 | £4,160 |
| Assessment costs | £955 | £1,214 | £1,307 |
| Finance costs | £847 | £1,522 | £1,701 |
| Cost to businesses (excluding ECO) | £1,011 | £945 | £1,052 |
| Administration costs | £40 | £40 | £40 |
| **Total costs** | **£14,946** | **£17,311** | **£18,840** |
| Energy savings (Variable element) | £12,717 | £14,988 | £16,176 |

| | | | |
|---|---|---|---|
| Comfort benefits | £2,822 | £3,450 | £3,749 |
| Air quality benefits | £1,243 | £1,434 | £1,560 |
| Lifetime non-traded carbon savings | £3,015 | £4,272 | £4,809 |
| Lifetime EU ETS Allowance savings | £1,401 | £1,471 | £1,522 |
| **Total benefits** | **£21,198** | **£25,616** | **£27,817** |
| **Net Present Value** | **£6,252** | **£8,305** | **£8,977** |
| Equity-weighted NPV | £15,439 | £20,241 | £21,907 |
| 2020 Non-traded carbon savings ($MtCO_2$ pa) | 1.4 | 1.8 | 2.0 |
| Life time non-traded carbon savings ($MtCO_2$) | 59 | 84 | 48 |
| **Cost effectiveness £/$tCO_2$** | -£55 | -£48 | -£44 |

111. Table 8 provides a breakdown of the key impacts by Green Deal and ECO Carbon Targets, ECO Affordable Warmth Target and non-domestic Green Deal.

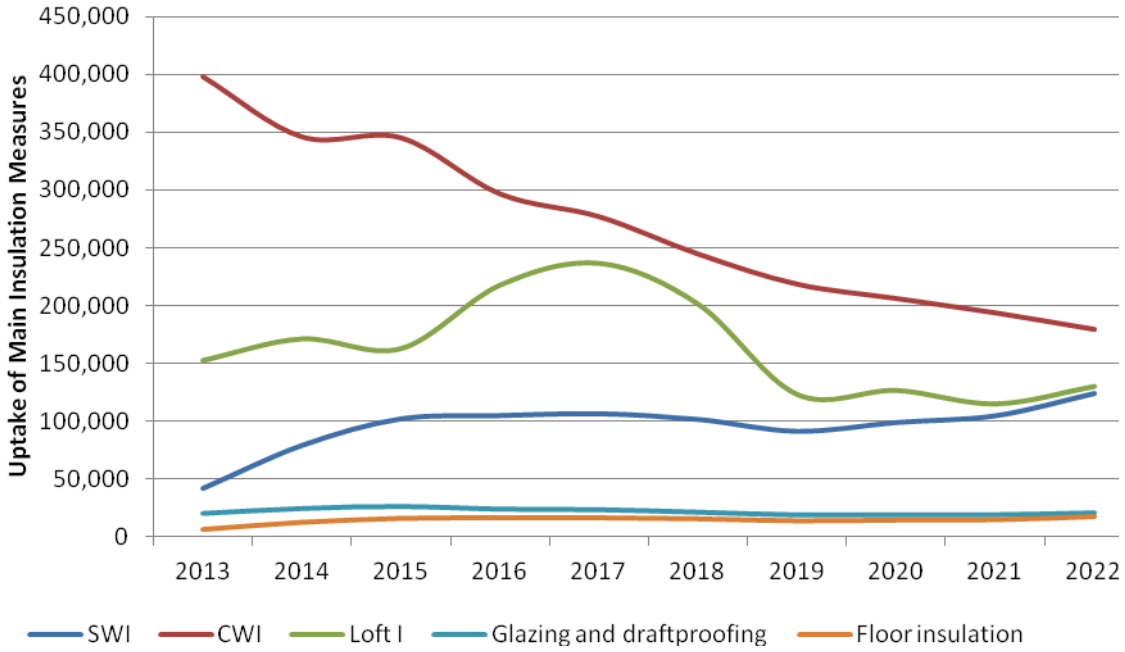
**Table 8: Breakdown of key impacts by Green Deal and Carbon Targets, Affordable Warmth and Non-Domestic Green Deal**

| | Green Deal and ECO Carbon targets | ECO Affordable Warmth target | Non-domestic sector Green Deal | Total |
|---|---|---|---|---|
| Total costs (£m) | £13,946 | £2,268 | £1,097 | £17,311 |
| Total benefits (£m) | £19,484 | £4,012 | £2,120 | £25,616 |
| Net present value (£m) | £5,538 | £1,744 | £1,023 | £8,305 |
| 2020 Non-traded carbon savings (Mt $CO_2$) | 1.76 | -0.82 | 0.91 | 1.84 |
| 2020 Energy savings (TWh) | 10.68 | -0.68 | 7.08 | 17.08 |
| Cost effectiveness £/$tCO_2$ | -£15 | N/A | -£73 | -£48 |

## 7.1 Uptake by measure

112. Figure 14 shows the uptake of the main domestic energy efficiency measures (excluding DIY loft insulation, which is outside the scope of the Green Deal). Uptake of cavity wall insulation is expected to decline over time as potential is used up. By comparison, uptake of solid wall insulation is expected to rise to around 100,000 p.a. in 2015. The delivery of packages of measures is expected to play a significant role in the Green Deal. Green Deal assessors will recommend a list of measure to be installed some of which will provide scope for cross subsidisation[56]. Economies of scope[57] are likely to mean that packages of measures will often be a cost effective way of meeting the Carbon Target. The analysis predicts that 23% of households taking up wall insulation also top up their loft insulation, and 10% take out another energy efficiency measure as part of the package. Figure 15 compares the uptake of CWI and SWI in the high, low and central scenarios. Figure 16, Figure 17 and Figure 18 show historical uptake rates for the different insulation measures and how this compares to expected demand in 2012, the last year of CERT and CESP and 2013, the first year of the Green Deal and ECO delivering measures.

**Figure 14: Uptake of main insulation measures in the domestic sector**




[56] Green Deal Finance raised on a measure with a low payback period could be used to part finance measures that would not otherwise meet the Golden Rule.

[57] Economies of scope are reductions in average cost arising from the production or sale of a number of different products

Figure 15: Uptake of wall insulation in central, low and high scenarios

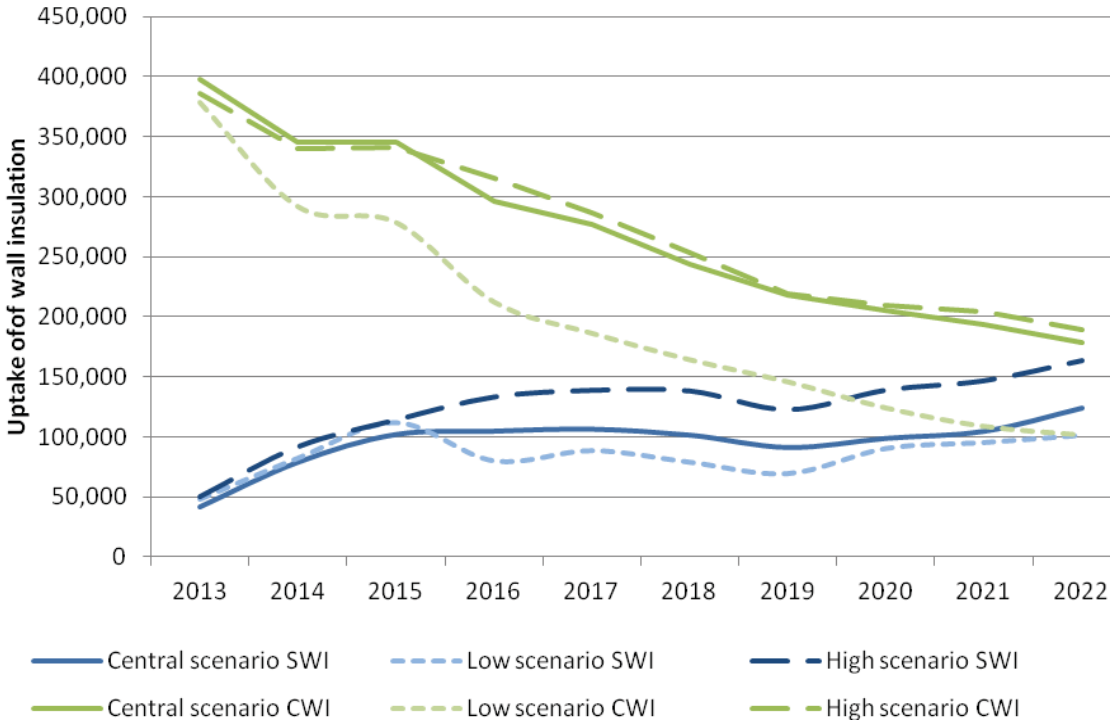


Figure 16: Historical and estimated 2012 and 2013 take-up of CWI

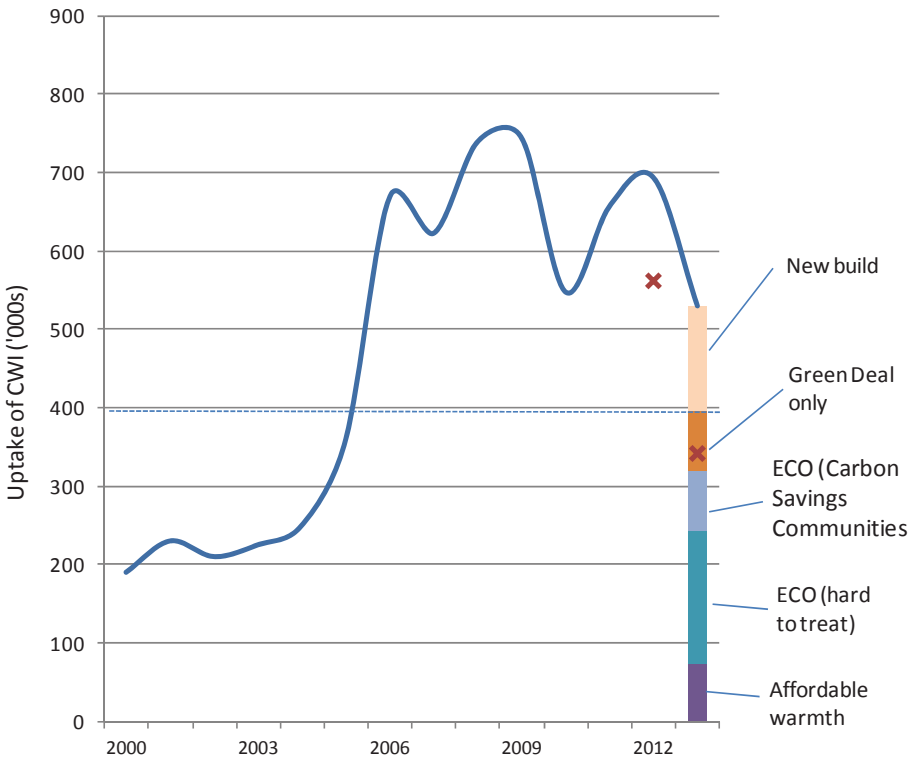



Figure 17: Historical and estimated 2012 and 2013 take-up of LI

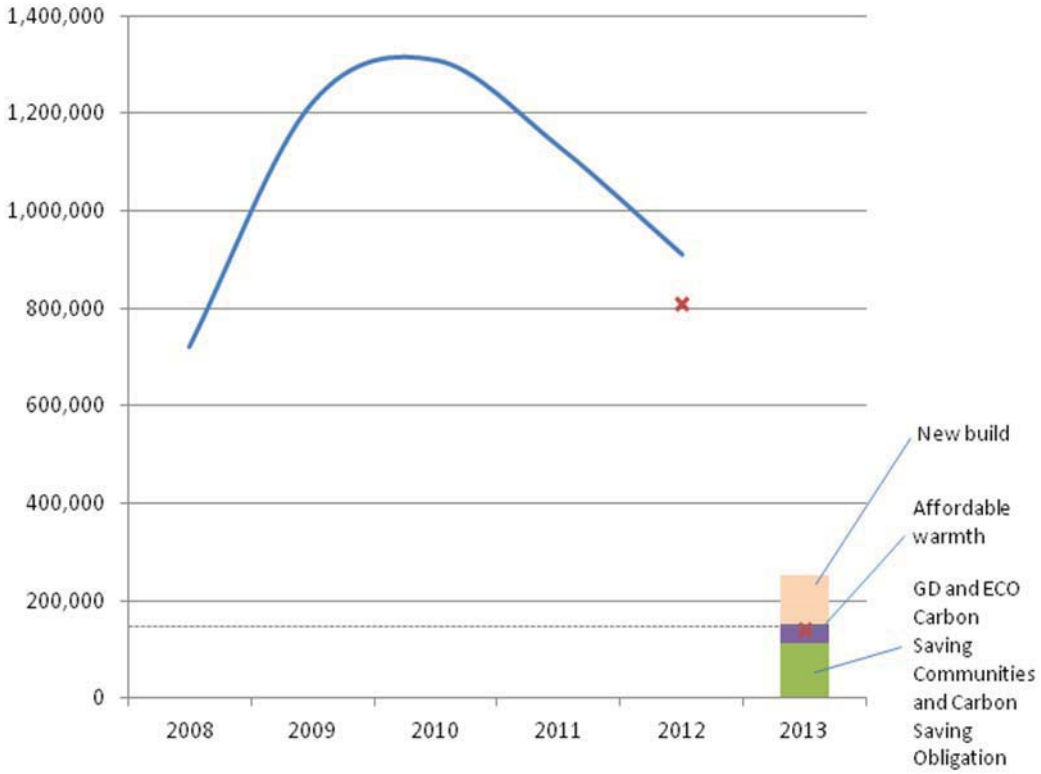
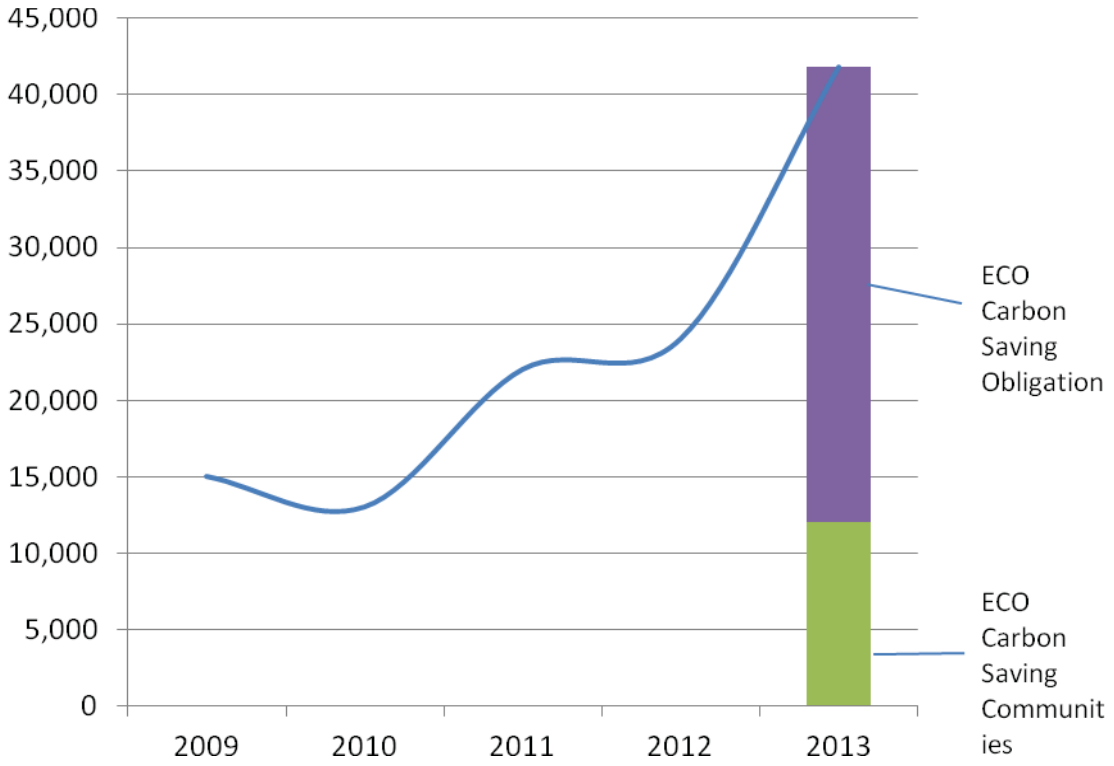


Figure 18: Historical and estimated 2012 and 2013 take-up of SWI




Box 2: The New Green Deal Market

This impact assessment's estimates for the size of the Green Deal market and take-up are based on the evidence in which government has most confidence. In the housing market, this gives a view of demand based on the level of the ECO obligations and the number of measures that will be required to meet them and, outside of the scope of the ECO, the regulation of the private rented sector, building regulations' energy efficiency requirements and other policies where there is some degree of government control. As such, there is confidence in delivering the expected 27.8 $MtCO_2$ by March 2015 (see section 7.5 for more detail). There are additional government policy levers which have not been included in the demand modelling either because they are not yet agreed or enacted (e.g. energy efficiency regulations relating to consequential improvements to existing buildings) or because there is no evidence currently that they are required (for example minimum D energy efficiency standards for all buildings). Given these considerations, there is significant longer term upside potential for the market for energy efficient home improvements to develop beyond government forecasts. A key aim of the Green Deal is to move to a market framework where businesses and other organisations, in addition to energy suppliers, can compete for energy efficiency opportunities in new and innovative ways.

Since the Green Deal and ECO's announcement in June 2010's Budget, 22 high profile organisations have expressed their intention to participate in the market and signed an agreement with government to work to become the first Green Deal providers. This Pioneer Providers group includes British Gas, E.ON, SSE, Carillion, Insta Group, Kingfisher, Mark Group, Gentoo, Wilmott Dixon Energy Services, Knauf, SIG and Re-Energise[58]. In addition, other organisations, such as Wolseley, NPower and EDF Energy have indicated they are strongly considering entering. They are considering a

[58] The full list of 22 organisations can be found at : http://www.decc.gov.uk/en/content/cms/news/pn12_042/pn12_042.aspx

variety of business models to deliver Green Deals to customers in innovative ways, across a variety of channels and leveraging a number of natural trigger points. A number of these are also involved in developing a financing solution through The Green Deal Finance Company.

Other early movers in the market are likely to include councils and registered social landlords, who can influence large stocks of housing under their stewardship. Being subject to Decent Homes standards[59], they already have experience in significant refurbishment programmes and are well equipped to identify energy efficiency opportunities. Budgets allocated to these improvements could also lead to ECO funding going further than would otherwise be the case.

Gentoo, a social housing provider in Sunderland has, in partnership with British Gas, piloted some of the principles of the Green Deal with its tenants. The programme aims to install packages of energy efficiency measures in approximately 1,100 properties. Some of the measures are subsidised through CERT & CESP[60], with a proportion of the remaining costs recovered through the application of a small charge on energy bills to the property for a 15 year period[61], or collected via the rent account. Up to early January 2012, 86% of their tenants had agreed to participate in the scheme with 71% opting to pay via their energy bill. Take up rates such as these are far greater than the central estimate predicted by the Green Deal Household Model.

The Greater London Authority's (GLA) '*Delivering London's Energy Future*' strategy states its intention to retrofit 1.2m homes in the Greater London area by 2015 (this is equivalent to 100% of the total number of homes expected to be retro fitted in the national Green Deal). The GLA intends to do this by working with all the London boroughs to build on the success of *RE:NEW*, its refurbishment programme, that has retrofitted 11,000 homes to date. The GLA is working to integrate *RE:NEW* with new energy efficiency and energy supply funding streams, such as the Green Deal and the Feed-in Tariff, so retrofitting can be offered to all London homes by 2030.

Many other local authorities are also planning for the Green Deal, including for example: Birmingham City Council (who are in the process of procuring a Green Deal delivery partner for a potential contract value of up to £1.5bn), Greater Manchester, and several consortia of councils such as the West Sussex County Councils. In so doing they are developing a mix of innovative delivery models including partnerships with social enterprises and commercial organisations.

One further factor that will contribute to demand upside is the £200m launch incentive fund, to be spent over eighteen months from October 2012. The principal impact of the incentive, as it has been modelled for the IA process, is to de-risk the Green Deal policy. There is further potential, depending on final policy design, for the launch incentive to contribute to supporting demand above that which has been modelled. The intention is for the incentives to support a range of measures not fully subsidised by ECO, including loft insulation, easy to treat cavity wall insulation and other measures.

## 7.2 Impact on investment and employment

[59] There is currently a backlog of 410,000 non-decent social homes in England. DCLG intends to allocate £2.1bn of capital investment over the Spending Review period to halve this number (see http://www.communities.gov.uk/housing/socialhousing/decenthomes/).
[60] Carbon Emissions Reduction Target and the Community Energy Saving Programme.
[61] With an indefinite service charge for any solar photovoltaic V installations

113. A key objective of the Green Deal Finance mechanism is to draw private finance into the energy efficiency market. This is projected to be between £1.0bn and £1.3bn for the first 3 years and to reach between £3.2bn and £4.1bn by 2022. Table 9 shows the amount of Green Deal finance raised in the central uptake scenario, for different finance assumptions. The low scenario assumes a proportion of measures will be paid for up-front rather than using Green Deal finance, the central run assumes all those who prefer to pay up-front are filtered out by the consumer survey and the high scenario assumes a greater amount of finance accruing from boilers. More detail on these scenarios is presented in Annex F.

**Table 9 Volume of Green Deal Finance in central uptake scenario under different GDF assumptions (£m)**

| | Low GDF scenario | Central GDF scenario | High GDF scenario |
|---|---|---|---|
| **2013** | £269 | £303 | £369 |
| **2014** | £354 | £392 | £464 |
| **2015** | £385 | £423 | £496 |
| **2016** | £400 | £437 | £501 |
| **2017** | £366 | £400 | £461 |
| **2018** | £313 | £341 | £399 |
| **2019** | £291 | £318 | £376 |
| **2020** | £272 | £296 | £355 |
| **2021** | £257 | £280 | £339 |
| **2022** | £262 | £283 | £343 |

114. The insulation sector has historically focused on the delivery of low cost cavity wall and loft insulation. The Green Deal and ECO will result in a move towards the delivery of more expensive measures. Installation rates of low cost measure such as loft insulation and CWI are expected to decline with higher priced, and labour intensive, measures such as SWI and hard to treat CWI increasing. This is expected to increase the overall number of jobs in the insulation sector. Table 10 sets out a range of estimates of the number of working hours it takes to install the main insulation measures.

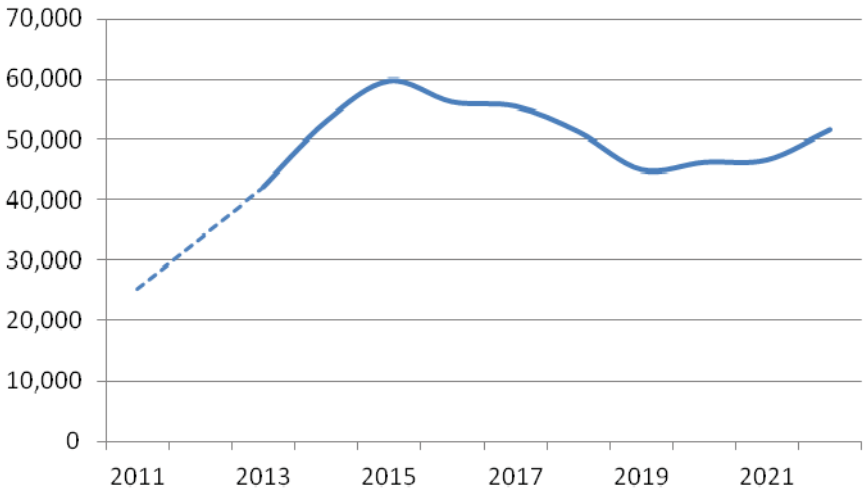
**Table 10 Estimates of the number of labour-days required to install different insulation measures**

| | Number of labour-days required to install | | Average number of measures per installer pa |
|---|---|---|---|
| | Low | High | |
| **External SWI** | 6.7 | 12.0 | 19 |

| | | | |
|---|---|---|---|
| **Internal SWI** | 5.4 | 8.0 | 26 |
| **CWI – easy to treat** | 0.4 | 1.0 | 251 |
| **CWI – hard to treat** | 1.5 | 5.0 | 54 |
| **Loft top up** | 0.25 | 0.3 | 640 |
| **Floor insulation part of a package** | 1.0 | 2.0 | 117 |

115. The move towards higher priced measures is expected to lead to an increase in the number of installers from around 4,700 in 2007 to around 9,800 by 2015. There will also be a positive knock-on effect on the wider supply chain which is expected to employ between 29,000 and 50,000 people by 2015, up from around 22,000 in 2007/8.[62] See figure, below, and Annex E for more detail.

**Figure 19: Estimated employment supported by installation of all insulation measures**



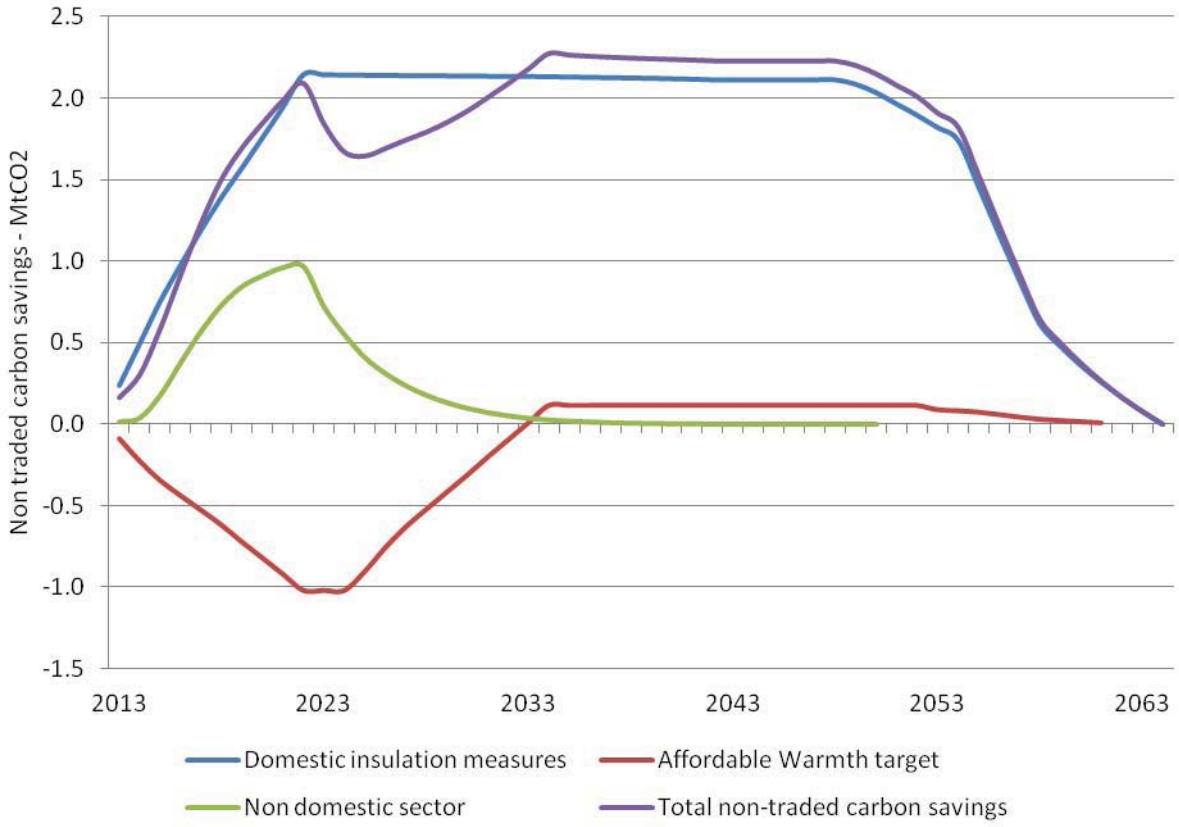

## 7.3 Carbon and energy savings

116. The Green Deal and ECO will reduce energy consumption and carbon emissions from households and businesses. Carbon emissions are divided into the traded (those covered by the EU Emission Trading System (EU ETS)) and non-traded sectors (those not covered by the EU ETS). The EU ETS covers electricity generation and the main energy-intensive industries (e.g. iron and steel, cement manufacture and chemicals) and it covers around 50% of UK GHG emissions. Reductions in energy consumption in properties with an electric heating system would therefore lead to reduced emissions under the EU ETS (traded carbon) due to reduced demand for electricity. For properties with gas, coal or oil heating systems, the reductions in

[62] Source: *Low Carbon and Environmental Goods and Services: an Industry Analysis*; Innovas; 2009

energy consumption will lead to lower emissions from the non-traded Sector (non-traded carbon). Figure 20 presents the projected impact on carbon dioxide emissions in the non-traded sector as a result of the policy package. By March 2015 and 2020, total carbon dioxide savings in the non-traded sector are 0.38Mt$CO_2$ and 1.8Mt$CO_2$ per annum, respectively.

**Figure 20: Non-traded carbon savings**




117. There are two factors that drive these results. The first is that as insulation measures are installed, carbon savings rise relative to the BAU scenario, and then gradually decline as measures reach the end of their lifetime. The second is that heating measures installed under the Affordable Warmth target are expected to lead to higher gas consumption, as low income and vulnerable groups benefit from homes that are cheaper to heat, in many cases also switching from electric secondary heaters (carbon emitted in the traded sector) to gas central heating (non-traded sector carbon). This leads to a reduction in the level of carbon savings in the non-traded sector.

## 7.4 Key Risks

118. The Green Deal and ECO policies are aimed at reducing the features of the market that lead to low take-up rates of energy efficiency measures, while also creating an environment in which the market for energy efficiency measures can grow rapidly. However, there are some outstanding risks that the policy cannot manage. It has not been possible to quantify the effects of all these risks, but most of them are presented in different combinations within the

sensitivity scenarios in section 7.5, below, and Annex F. The risks fall into the following categories:

- **Market failures:** The policy will ease all the market failures detailed in section 3.2, and address, in particular, the mis-alignment of incentives in the rental market, capital constraints and high discount rates, all of which result in under-investment in energy efficiency measures (also see section 3.5 for more details of how the policy addresses these failures). It is not currently possible to quantify the extent to which these failures will be addressed.
- **Consumer appetite for measures:** The analysis underpinning the results presented in this document are informed by survey evidence, calibrated according to the delivery of measures under existing energy company obligation schemes. There is a risk that households do not make energy efficiency decisions in the same way as assumed. There is also a risk that households could react disproportionately to any adverse publicity.
- **Costs and the performance of measures:** The cost effectiveness of all the measures covered in this document depend on the relationship between energy prices, the measure's cost and its in-use performance. A lot of analytical work underpins the assumptions made about these elements although, in a dynamic market, these can always be superseded by new evidence.

## 7.5 Sensitivity analysis

119. As discussed above, there is considerable uncertainty around the aggregate impacts of the policy package. The ability of models to fully capture the likely uptake of measures is limited, given the innovative and open market characteristics of the Green Deal and ECO policy framework. The Green Deal will enable the development of new business models and delivery systems, therefore predicting the uptake of Green Deals in the market is inherently difficult. A number of sensitivity scenarios have been used to illustrate this uncertainty. The obligations under the ECO are quantity targets – there is a high degree of certainty, once set, that the required savings will be achieved. What is uncertain is the cost to energy suppliers (and therefore the passed through cost to bill payers) of achieving these savings. The analysis shows that the costs of delivering the ECO Carbon target vary considerably between different scenarios.
120. Outside of the ECO the uptake of measures eligible for Green Deal finance is uncertain, as is the split between households and organisations opting for Green Deal finance[63] and those choosing to self-fund measures or use alternative finance. These will affect the amount of

[63] Some measures are more likely to be financed through Green Deal finance and others by alternative financing means. Low cost measures, such as loft insulation, are more likely to be self funded by households, as the costs of Green Deal finance are high for those who do not need to borrow. For higher cost measures, lower cost forms of finance may be open to households, such as extending a mortgage. These cost savings could be outweighed by the benefits of keeping the finance connected to the property, rather than the household, however.

Green Deal finance that is likely to be raised and the total reduction in carbon emissions. The key sensitivity scenarios are set out below and more details can be found in Annexes A and F.

- **Energy prices**. Energy prices have a significant impact on the attractiveness of energy efficiency measures and on the amount of Green Deal finance that can be raised by installing a particular measure. The analysis presented is consistent with DECC's published fossil fuel price scenarios.[64] The central energy prices scenario used in this analysis is consistent with an average annual increase of 1.8% to 2022 (in real terms). This is compared against a high energy price scenario (an average annual rise of 3.9%) and a lower energy price scenario (a fall of 32% by 2013 followed by an average annual rise of 2.7%).

- **Consumer demand**: The number of households that choose to take up Green Deals in each year is based on the responses to the Green Deal consumer survey. The consumer preference function has also been adjusted to account for the impact of factors that were not included in the survey, such as marketing activity by Green Deal providers. However, there remains considerable uncertainty around how attractive the Green Deal will be to different households. The analysis includes high and low 'consumer preferences' scenarios to illustrate this uncertainty.

- **Interest rates**: The interest rate offered by Green Deal providers affects the amount of finance that can be raised and the total cost of a measure to the consumer. To keep the rate low, potential Green Deal Providers are exploring options including the creation of a special purpose aggregation vehicle which would be able to generate the scale required to access the lowest cost of finance on the capital markets. Following independent analysis, the central rate for this IA has been set at 7.5% (up from 7% in the consultation stage IA) and the sensitivity analysis uses a low rate of 6.5% and a high of 9.5%. The rate assumed for the non-domestic sector is 8% (the same as in the consultation IA). See Annex I for more detail.

- **SWI Energy savings**: The low historic sales of SWI means there is currently little in-situ data on actual energy savings delivered. The IA therefore includes a range of SWI energy saving estimates to illustrate the impact of the current uncertainty . See Annex A for details.

- **SWI learning rates**: There are a of number reasons to believe that the costs of SWI will fall as the industry is scaled up to meet the Carbon Saving Targets but the extent of these cost reductions is unknown. The central estimate is a fall in installation costs of 15% by 2022, based on the cost reductions seen in the CWI sector and feedback from industry. The sensitivity analysis uses a high and low estimate of 10% and 20%.

- **Assessment costs**: The Green Deal is a market mechanism and providers will be free to develop the offer to consumers that is most effective at driving sales. The way in which assessment costs will be recovered is unknown but a number of models could be adopted. The central estimate is based on the assumption that Green Deal providers provide the assessment at no upfront cost, provided the customer then takes up a Green Deal (the costs

[64] See Annex A for fossil fuel price assumptions and Annex F for sensitivity modelling results.

are then included in the overall Green Deal package). Half of the costs of the unsuccessful assessments[65] are also included in the cost of packages to consumers. A sensitivity scenario is included in which providers offer the assessment free and pass on the full costs of unsuccessful assessments to Green Deal customers.

- **Change in the decision making frequency**: The different assumptions around how the decision making frequency may change over time have also been incorporated. A low estimate of uptake has been based on the assumption that once households have a Green Deal assessment and decide not to take up a plan they are permanently removed from the stock of eligible households. A high estimate of uptake has used the assumption that the decision making frequency for SWI rises over time as households become more familiar with the technology.

- **Action by local authorities and communities**: Economies of scale in the installation of SWI mean there is considerable scope to reduce costs by treating multiple properties at once. The central estimate incorporates these cost reductions for the delivery of external SWI in the social housing sector. A sensitivity scenario is included in which action by local authorities and communities to co-ordinate delivery allow further economies of scale to be realised in the owner occupied and private rented sectors.

- **Minimum bill savings for customers**: Green Deal providers will be free to develop the package they offer consumers. The current demand for measures is based on responses to the Green Deal consumer survey. However, there is other evidence that suggests consumers may require significant net bill savings upfront in order to take action. A sensitivity scenario has been used to illustrate the impact on demand if consumers require a minimum level of net bill savings in year 1 in order to take up a plan.[66]

121. These sensitivity scenarios have been combined to create a high and low estimate of the impact of the policy package. The high scenario reflects a significant increase in the demand for SWI and combines the following sensitivities: low interest rates, high SWI learning rates, rising SWI decision making frequency and strong action by local authorities and communities. The low scenario reflects a low demand for Green Deal packages and uses the following sensitivities: high interest rates, high Green Deal assessment costs, minimum bill savings from consumers and a falling decision making frequency.

### Carbon targets

122. The uncertainty associated with the estimates presented in this section have a different impact on the uptake of measures inside and outside the scope of ECO. For measures inside the scope of ECO the main risk is around the cost of delivery, rather than the quantity

[65] Assessments that do not lead to a Green Deal being taken up. The uptake rate for households that have an assessment is assumed to be 1-in-3 meaning there are 2 unsuccessful assessment for each green Deal taken up.
[66] The maximum annual repayment is 75% of the total bill saving.

delivered. Measures within scope of ECO are projected to make up around 83% of all measures delivered in the central scenario to 2022.

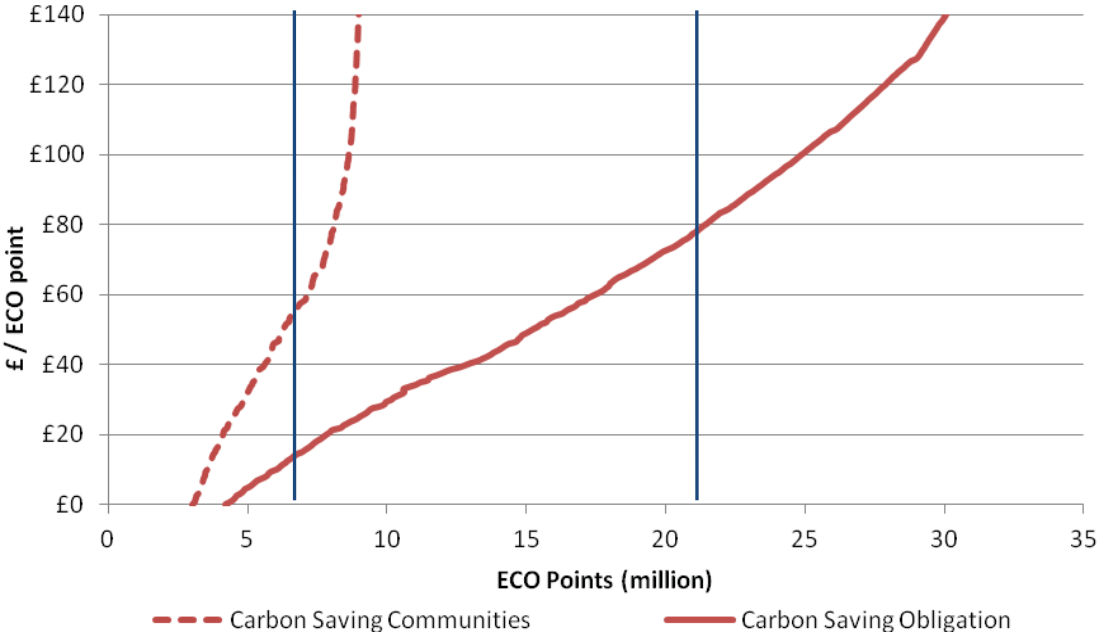
123. The central estimate of the cost to energy companies of meeting the ECO Carbon Targets is £950m per year plus an additional £350m per annum to meet their Affordable Warmth obligations. Energy companies are expected to meet the target by providing subsidised measures to households. The actual installation work will not necessarily be conducted by energy companies; the obligation could be contracted out to a range of firms operating in the sector including Green Deal providers. Independent firms will also be able to generate "ECO points"[67] independently and sell them on the ECO brokerage market. The subsidy will also often be combined with Green Deal finance. The actual rate of subsidy provided will depend on a wide range of factors. For example, if energy prices rise faster than expected, energy efficiency measures will lead to higher bill savings and so lower subsidies will be need to deliver the same benefit to consumers.

124. The ECO Carbon Saving Obligation target and Carbon Saving Communities target (with its Rural Safeguard) will require energy companies to deliver lifetime $CO_2$ savings. The cost of meeting the carbon reduction obligation will therefore depend on the amount energy companies will need to spend to incentivise enough households to take up energy efficiency measures (each of which will provide a certain $CO_2$ saving, effectively a value in terms of 'ECO points').

125. The GDHM has been used to provide an estimate of the number of ECO points ($tCO_2$ savings) that would be delivered for a given level of subsidy (£ per ECO point, or per lifetime $tCO_2$). This analysis provides an estimate of the ECO point supply curve (the number of ECO points delivered for different levels of subsidy), which is illustrated in Figure 21 below. The carbon targets for the periods January 2013 to December 2015 are shown as vertical lines and the point at which they cross each supply curve will determine the level of subsidy per ECO point required to deliver the targets. The actual carbon target is set between January 2013 to March 2015 and is 27.8 $MtCO_2$. This total carbon target comprises 20.9 $MtCO_2$ for the Carbon Saving obligation target and 6.8 $MtCO_2$ for the Carbon Saving Communities target (of which 15% (1 $MtCO_2$) is the Rural Safeguard target). The point at which both curves meet the x-axis shows the amount of carbon that would be delivered by measures covered by ECO if no subsidy was provided (£0 / $tCO_2$).

[67] Energy suppliers will install eligible measures and count the associated lifetime carbon savings, as calculated using the Green Deal assessment tool, to meet their ECO carbon targets. CSC and CS carbon targets will be calculated on the basis of lifetime carbon savings of insulation measures - 1 ECO point per $tCO_2$ saved over its lifetime. AW targets are calculated on the basis of lifetime notional heating cost reduction from insulation measures and heating systems. See Annex H for further details.

Figure 21 Central ECO point supply curve – 2013-15[68]




126. There is a high level of uncertainty around the position and gradient of the ECO point supply curve. The sensitivity analysis has been used to produce a range of possible supply curves to illustrate how the cost of meeting the Carbon Saving obligation target will vary. These are shown in Figure 22. In all cases, the level of the Carbon Saving Obligation target will be fixed but the rate of subsidy needed to deliver the target varies. This will have an impact on the total cost of delivering the ECO carbon target, as illustrated in Figure 24.

127. The Energy Act 2011 includes new powers which will allow the Secretary of State to monitor closely the measures delivered under ECO and crucially the cost to the energy companies of delivering these measures. The brokerage market will also provide transparent information to Government on the costs of delivering measures in the wider marketplace[69]. This information will allow the Government better to understand the inherent uncertainty around the total cost of delivering the ECO. Alongside this close monitoring, DECC will also carry out a more comprehensive review of delivery as part of wider evaluation of the Green Deal. This review is expected in the first half of 2014, when the delivery of ECO and Green Deal has bedded in.

[68] The modelling analysis is based on simulating annual uptake of measures. The ECO supply curves presented in this section are for the period 2013 to 2015. The actual ECO interim target will be set for the period Jan 2013 to March 2015. Proportion of the carbon target delivered in the first three months of 2015 with therefore be set on a prorate basis.

[69] The Government will be consulting on the brokerage market later in 2012.

Figure 22 ECO point supply curve for Carbon Saving Obligation in High, Central and Low scenarios

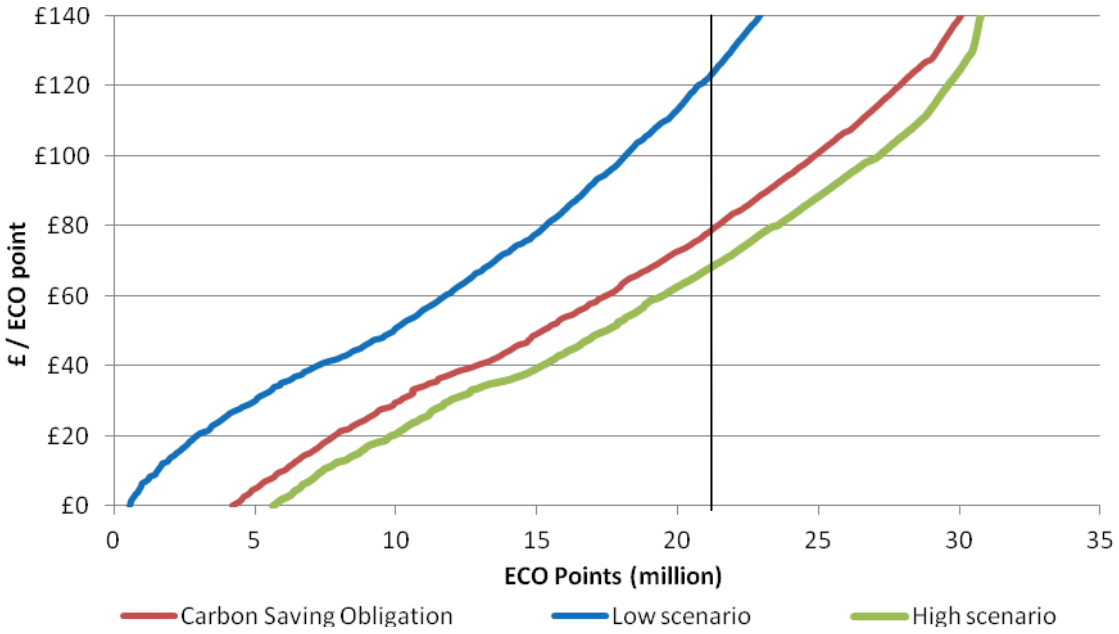
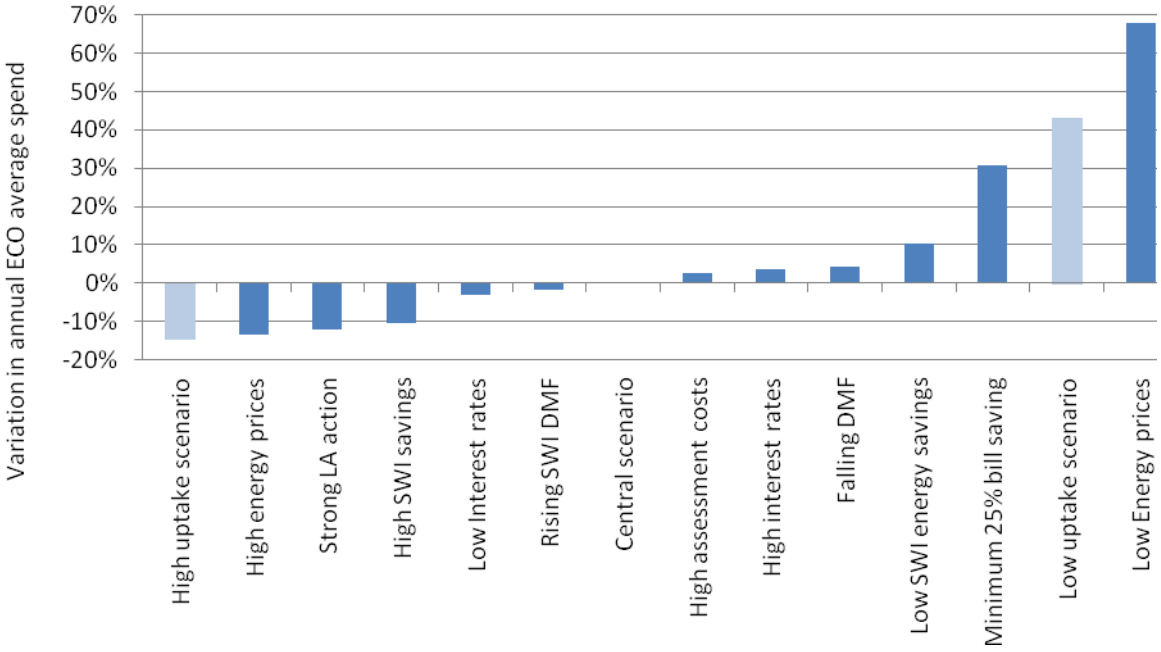



Figure 23 Variation in annual cost of meeting the first interim ECO Carbon target for different sensitivity scenarios



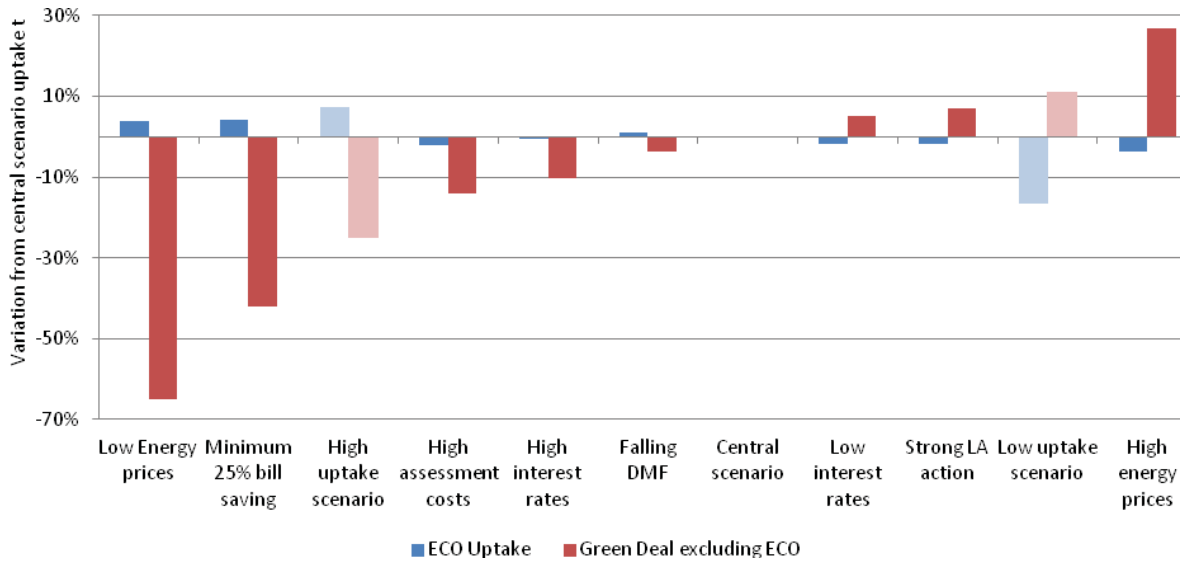

## Green Deal demand

128. For the measures that are outside of the scope of ECO, uptake will depend on a large number of factors. The Green Deal is a market based mechanism which will enable the development of new business models and delivery systems. The policy does not impose specific delivery requirements on providers but they will be free to develop a range of offers to consumers and businesses. Predicting the uptake in this section of the market is inherently difficult. The Green Deal is an innovative market instrument and participants offers to consumers have not yet been fully developed. The sensitivity analysis therefore provides a

wider range of uptake estimate of Green Deal only measures. A number of measures will be put in place to manage this uncertainty during the roll-out of the Green Deal, including a comprehensive evaluation strategy and reviews as discussed above.

129. Figure 24: shows the total number of Green Deal packages taken up in the different sensitivity scenarios, split between the ECO-funded packages and the Green Deal only packages. The total carbon saving from the ECO is fixed in all scenarios, but the proportion of the target that is met from SWI and CWI installations does vary (owing to changes in the relative cost effectiveness of each type). The take up of Green deal only packages ranges from 27% higher to 65% lower than the central estimate, compared to a range of 4% higher to 4% lower for the number of ECO packages.[70] As mentioned previously in the IA, the there is a high level of uncertainty associated with the projections associated with the Green Deal mechanism, given its innovative an open market nature of this.

**Figure 24: Variation in uptake of measures by March 2015 financed by ECO and Green Deal, and Green Deal only**




## 7.6 Aggregate impact of the Affordable Warmth target

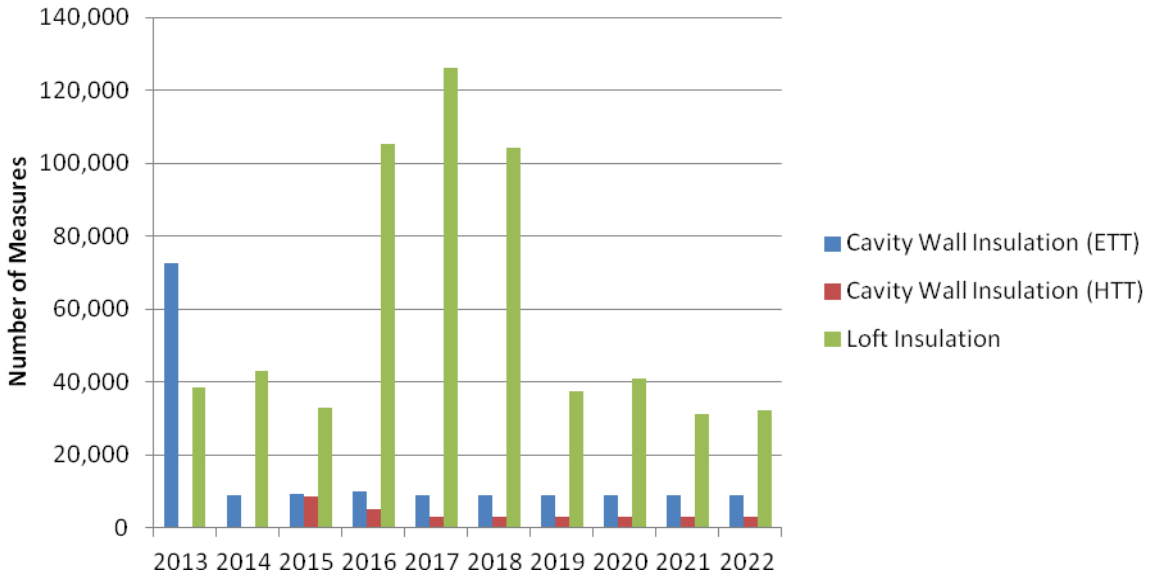
130. We estimate that around 1 million heating measures and around 770,000 insulation measures will be delivered under the ECO Affordable Warmth Target by the end of 2022. In the first period of ECO (October 2012 – March 2015) we estimate that around 280,000 heating measures and around 180,000 insulation measures will be delivered, assuming that measures are delivered from the very beginning of the obligation (see 'Setting the Affordable Warmth Target' below for detail on how this relates to the Affordable Warmth target). Over the lifetime of the measures this leads to estimated actual energy bill savings for low income and vulnerable households of around £8.9bn, carbon emission reductions of around 20 $MtCO_2e$ in the EU ETS sectors, and an increase of around 9 $MtCO_2e$ in the non-traded Sector.

[70] CWI saves less carbon per installation which leads to small changes in the total number of ECO / Green Deal packages

131. The delivery of insulation measures under the AW target in the first year of the ECO Affordable Warmth is dominated by lower cost CWI and LI. This is driven by the relatively high availability of opportunities to install easy-to-treat Cavity Wall Insulation at the beginning of the policy, and the expectation that energy suppliers will aim to deliver the most cost-effective measures first. Differences in projected delivery levels of loft insulation across years is driven by the gradual exhaustion of more cost-effective opportunities in the earlier years, increasing the projected attractiveness of loft insulation as a means of meeting the Affordable Warmth target from 2016-2018, before projected changes in energy prices towards the end of the decade alter the most cost-effective mix of measures.

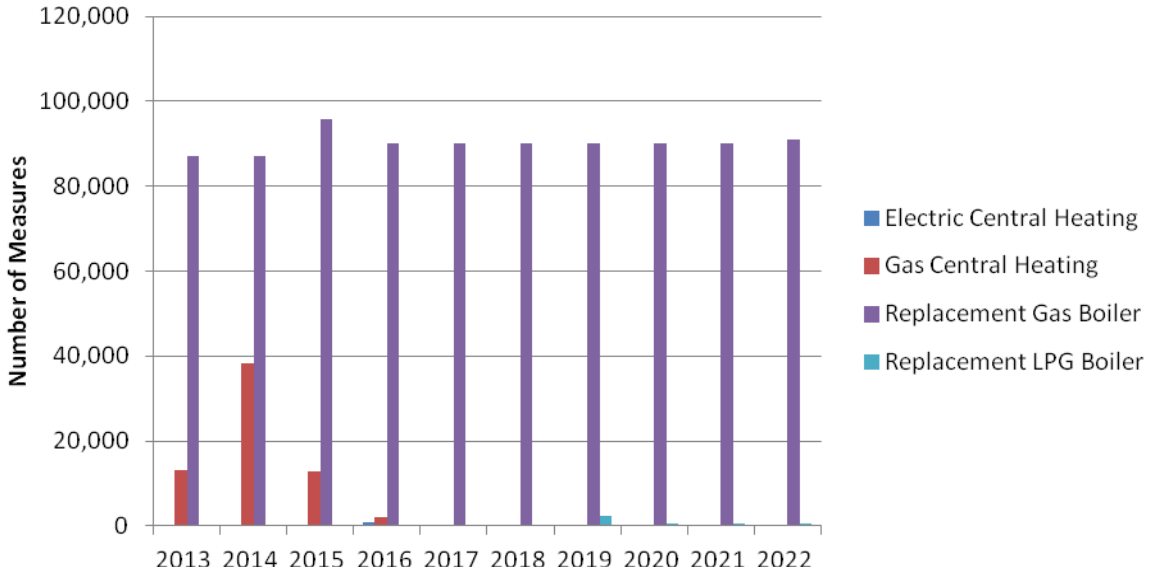
132. In total, around 590,000 Loft Insulations and 150,000 easy to treat cavity wall insulations are delivered to the end of 2022. The uptake of hard to treat Cavity Wall Insulation is estimated at around 30,000 while a nominal number of Solid Wall Insulation installations are delivered in the modelling.

**Figure 25 Estimated number of insulation measures installed under the Affordable Warmth Target, 2013-2022**




133. The main heating measures installed in the modelling are replacement gas boilers, around 900,000 estimated to be delivered by the end of 2022, with a smaller number of new central heating systems being installed in dwellings where no central heating previously existed (around 70,000 are estimated to be delivered). The installation of new gas central heating is projected to be concentrated in earlier years, with a greater emphasis on the delivery of replacement boilers and insulation in later years as opportunities to deliver new central heating are exhausted.

Figure 26 Estimated number of heating measures installed under the Affordable Warmth Target, 2013-2022




## Setting The Affordable Warmth Target

134. The Affordable Warmth target will require energy suppliers to achieve a total reduction in lifetime notional space and water heating costs of £4.2bn. Suppliers are expected to meet this target by delivering predominantly heating and insulation measures to households eligible for support under the target. The total cost of delivering these measures will depend on the costs of each measure delivered and the mix of measures delivered. The Affordable Warmth model has been used to estimate the cost associated with delivering this level of notional heating cost reduction. The central estimate of the cost to energy suppliers of meeting the Affordable Warmth target is around £350m per year. An allowance has been made for the possibility that Affordable Warmth delivery may take some time to ramp up over the first three months of the obligation, and therefore the target has been set on the projected delivery of measures from January 2013 – March 2015, with some further allowance for uncertainty around the level of low cost CWI opportunities. As a result, it is expected that the target could be met based on the projected delivery of around 260,000 new and replacement heating systems, and the insulation of around 45,000 cavity walls and 90,000 lofts.

135. The target has been revised upwards since the consultation Impact Assessment. This is a result of three factors (see Annex D for more details):

- The heating cost reductions in the revised target relate to space *and* water heating from the installation of heating systems, whereas the original target did not include water heating. This update reflects final decisions on the Affordable Warmth target metric.
- Revised estimates of the number of 'easy-to-treat' cavity walls. Low cost cavity wall insulation is the most cost-effective measure in achieving lifetime notional heating cost reductions, and increasing the estimated number of 'easy-to-treat' cavity walls means that a greater level of cost reductions can be achieved for the same level of resources.

- Updated cost estimates for heating measures. The estimated costs of new and replacement heating systems in the Affordable Warmth model are based on data from previous Government backed energy efficiency schemes. The cost estimates included in the modelling of the original target have been updated, with the revised estimates resulting in a more significant number of heating systems being delivered for the same level of resources.

## 7.6 Aggregate impact of Green Deal in the non–domestic sector

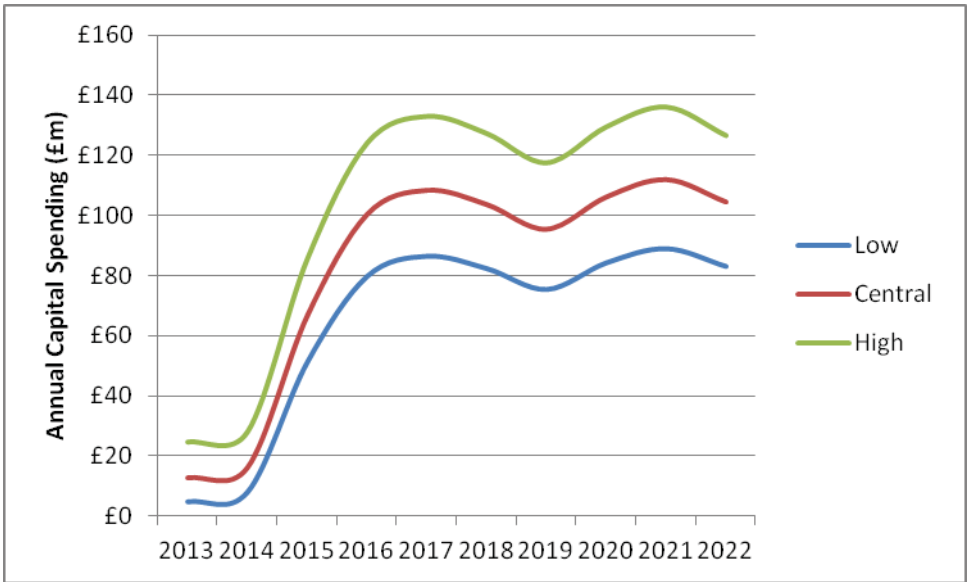
136. The estimated impacts of the non-domestic Green Deal and associated supporting policy vary depending on the assumptions made. The majority of the variation derives from the assumptions surrounding the analysis of the supporting policy in the PRS.[71] This reflects not only the likely scale of the policy relative to the non-domestic Green Deal, but also the uncertainty surrounding the precise nature of the policy and how it is implemented.

137. Figure 27 presents the expected take-up of measures as a result of the policies, which peaks between 2015 and the early 2020s. Capital spending on annual installation in the central scenario vary between around £100m pa and £115m pa during this period. Take-up resulting directly from the Green Deal peaks in the early years of the policy, and declines over time as more and more abatement opportunities are exhausted.

138. For the purposes of the analysis, take-up as a result of the supporting policy in the PRS peaks in the year the policy enters into force, with installations occurring up to four years in advance of the policy as a result of market anticipation. 62% of the non-domestic properties are in the PRS. Take-up is closely related to the lease period, and reflects the number of properties that begin a new lease in a particular year (see Annex C).

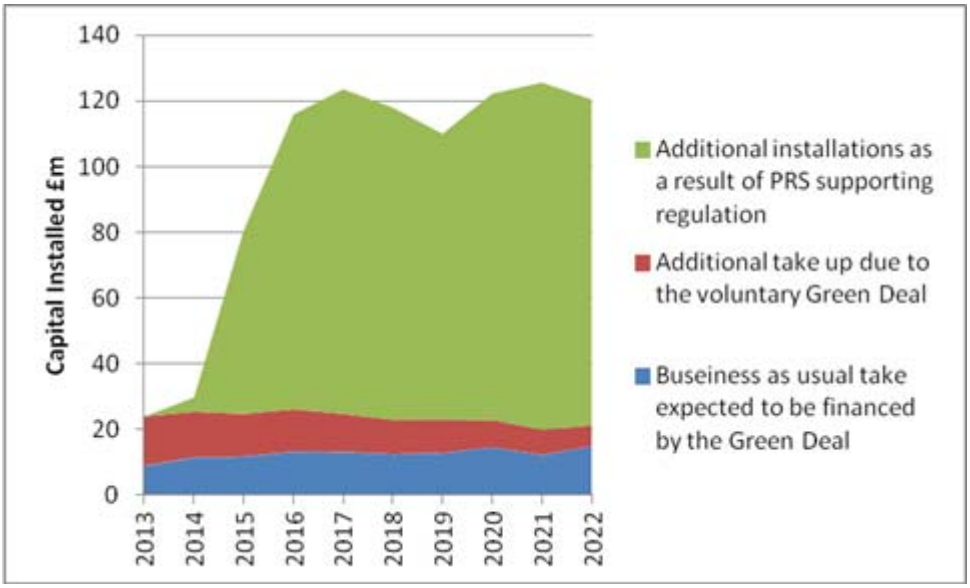
[71] From April 2018, all private rented properties (domestic and non-domestic) should be brought up to a minimum energy efficiency standard rating, likely to be set at EPC rating "E". This requirement would be subject to there being no upfront financial cost to landlords. The intention is that landlords would have fulfilled this requirement if they had either reached "E" or carried out the maximum package of measures funded under the Green Deal and/or ECO(even if this does not take them above an "F" rating See annex B for further details..

Figure 27: Green Deal take-up in the non-domestic sector (Green Deal and supporting policy in the PRS



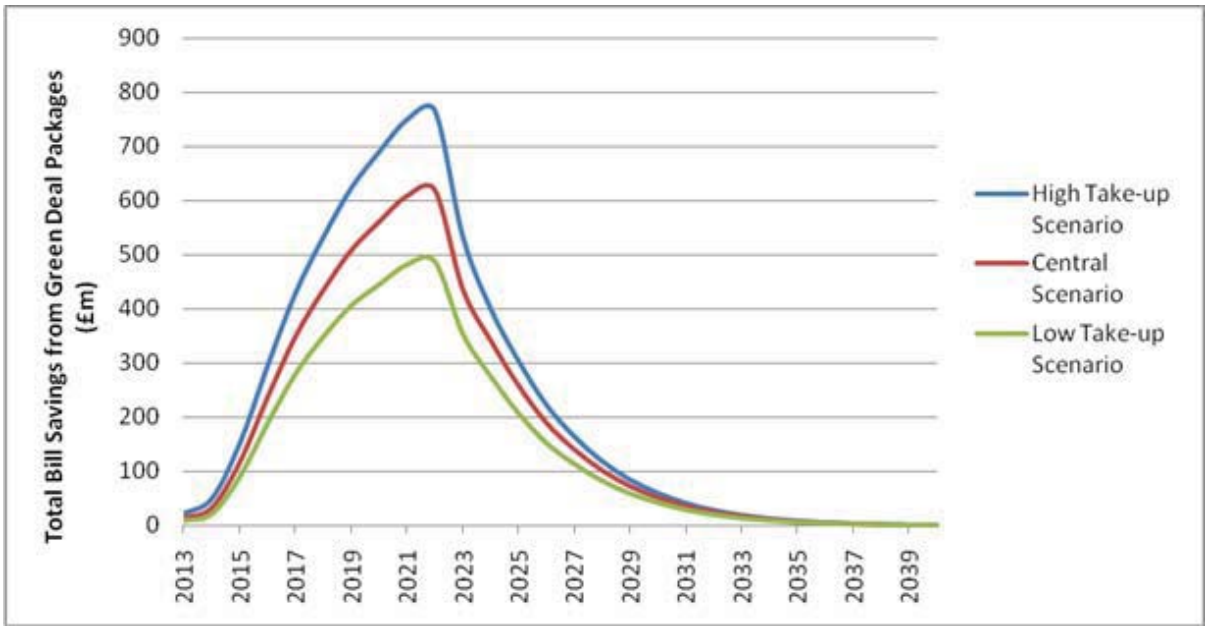

139. Figure 28 shows the estimated take-up of Green Deal packages including those taken-up by those organisations who, in the business as usual, undertake capital investment but now use the Green Deal to finance it.

Figure 28 Green Deal packages take-up in the non-domestic sector




140. The take-up scenarios presented above, deliver a bill savings profile on the energy saved shown in Figure 29, below. These exclude the Green Deal charge but, as the average Green Deal package is assumed to pay back in five years, a significant proportion of these savings will be kept by those choosing to take out a Green Deal. The profile of the savings drop off quickly after the Green Deal programme ends in 2022. This is because we have assumed that measures for non-domestic buildings are on average shorter lived than those taken out in the domestic sector.

Figure 29 Non-domestic sector's bill savings after capital payments have been excluded




## 7.7 Distribution of costs and benefits

141. The impact of the Green Deal and ECO will vary between different groups within society. In the domestic sector, the benefits from energy efficiency measures will be concentrated in households that install them. These households will also contribute to the installation and assessment costs though the Green Deal repayments. By comparison, the costs borne by energy companies of meeting the ECO will be passed on to all domestic energy consumers, in the same way that energy companies currently pass on their costs of achieving their CERT and CESP targets. There will, therefore, be some households whose bills will be lower following the introduction of the policies and some households whose bills will be higher than in the absence of any carbon saving policies. Some of the costs resulting from the implementation of the policy package will also fall on businesses. Energy companies will incur the costs of meeting the ECO targets and the cost of administering the Green Deal payment process. There will also be costs resulting from the accreditation framework and operating Green Deal finance mechanism.

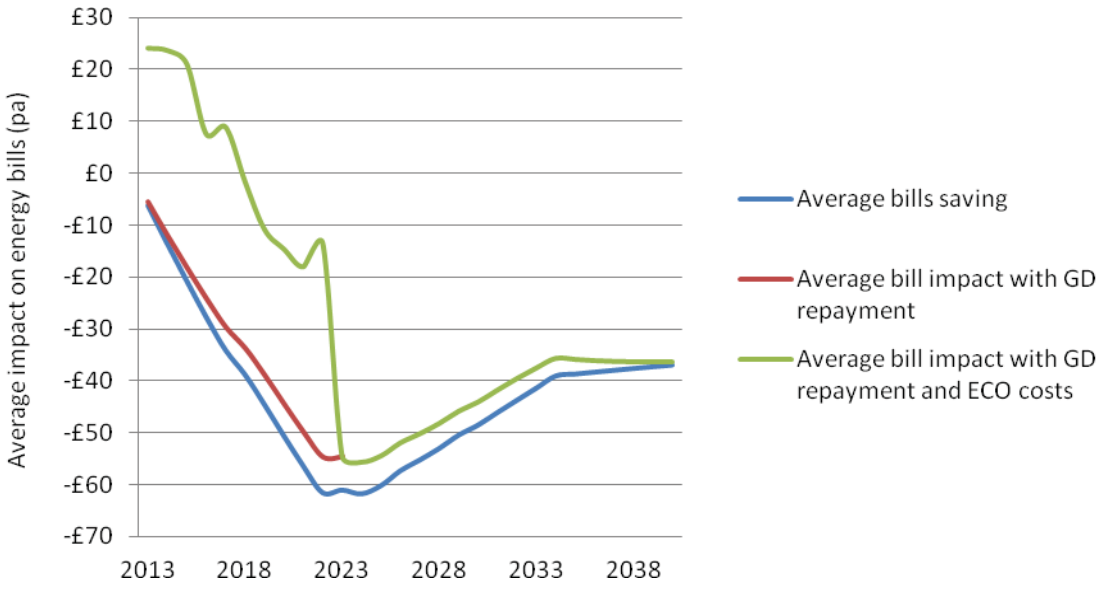
142. For households and businesses that take out a Green Deal plan, the benefits of reduced energy consumption would be partially offset by the Green Deal repayments needed to cover the installation and assessment costs. However, as energy prices are expected to rise, Green Deal customers are likely to see growing savings on their energy bills over time.

### Average impact on household energy bills

143. Figure 30 shows the central estimate of the average impact of the Green Deal and ECO on household energy bills, relative to there being no carbon savings policy in place. The

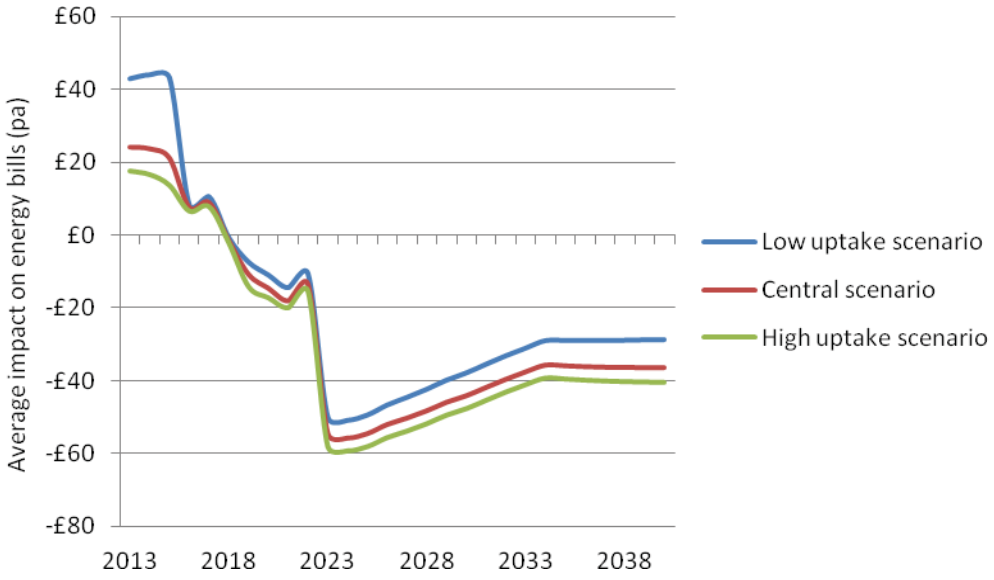
installation of energy efficiency measures is expected to lead to lower energy bills compared to the BAU scenario. Households are likely to face the costs of ECO, which will be passed on by energy companies as higher energy prices. Once the Green Deal repayments have been included the average impact is smaller, but bills are still lower. Figure 30 shows that the pass-through of ECO costs is likely to dominate during the period to 2017. However, this does not mean household energy bills will rise in 2013 due to the introduction of the ECO. The ECO will replace the existing supplier obligations (CERT and CESP) the cost of which are already reflected in current energy bills.

**Figure 30 Impact of Green Deal and ECO on average annual energy bills**




144. The impact on energy bills will vary depending on the cost of meeting the ECO targets. Figure 31 illustrates the range of impacts under the different uptake scenarios. In the Low Uptake scenario, fewer measures are taken up and energy companies are required to provide higher subsidies to meet the first carbon targets. This leads to a higher net impact on energy bills and smaller savings. In the high uptake scenario, more measures are delivered and subsidies are lower, leading to a smaller rise in bills and deeper savings.

Figure 31: Impact on average annual energy bills in different sensitivity scenarios



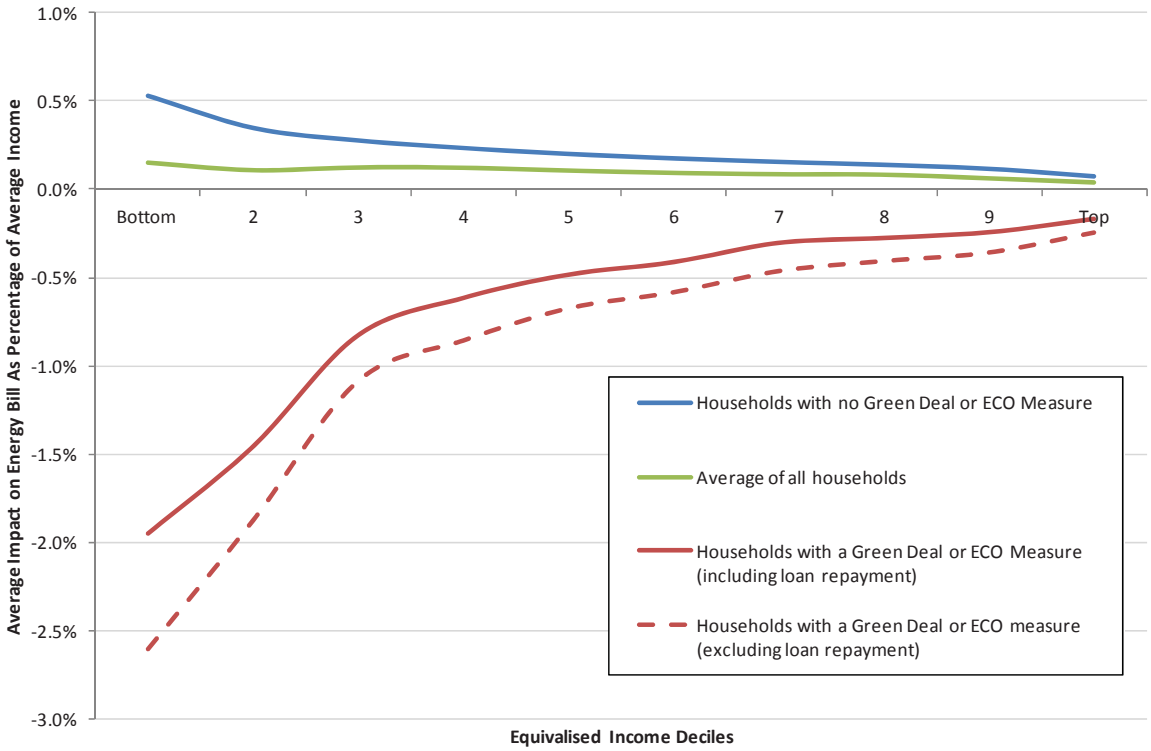

## Distributional impact of change in energy bills

145. Figure 32 shows the projected impact of Green Deal and ECO on energy bills across different income groups in 2020. The costs of measures delivered by Green Deal finance will be borne by the beneficiaries of the measure, but the ECO is expected to be funded through energy bills. This means that those households that do not take-up a measure under the Green Deal or ECO will – compared to no carbon saving obligation being in place - see their bills increase; while those taking up measures will see their bills decrease significantly as a proportion of income, in particular those in the lowest income groups. The average impact across all households is a slight increase in bills, but with a broadly similar impact across the majority of income groups. This indicates that, despite the potential for costs being recouped through bills to be regressive, the average impact across income groups is broadly proportionate as a percentage of average income in each income decile group[72]. It should be noted however the majority of households in each income group are on the blue line (households with no Green Deal or ECO measure), and not on the red lines (households with a Green Deal or ECO measure), and for

[72] This presents a revised picture to that detailed in the consultation Impact Assessment, where, on average, less well-off groups saw their bills rise proportionately more than better-off groups as a percentage of expenditure. The more even distribution of average impacts across groups is primarily a result of a greater share of ECO resources being explicitly targeted at lower income groups through the Carbon Saving Communities obligation; but also in part due to the decision to allocate the ECO on a per kWh basis rather than customer accounts (see Annex H), as well as higher total projected delivery rates of measures, and the proportion of which that go to low income households under both the Affordable Warmth and Carbon Savings targets. The average bill saving for those taking up measures is lower as a percentage of income across the majority of income groups compared to the consultation Impact Assessment, which is driven by a change in the mix of measures delivered. Figure 32 includes a greater number of measures delivered with relatively smaller associated bill savings, such as loft top-up insulation, compared to the consultation Impact Assessment which included a mix of measures with a greater concentration of solid wall insulation and heating systems. Uncertainty remains around the distribution of Green Deal and ECO funded measures across different groups, which is discussed in Annex H.

these households the resulting average increase in bills is a greater proportion of average income for those in lower income groups than in wealthier groups.

**Figure 32 Distribution of impact on energy bills for different income groups in 2020**




146.

## Uptake of insulation measures by tenure

147. A significant proportion of the uptake of SWI is expected to be in the social housing and private rented sectors. Partnerships with social housing associations and local authorities will allow energy companies to benefit from economies of scale in the delivery of SWI, enabling them to meet the targets more cost effectively (see Box 2 for more information). The implementation of the regulation of PRS F and G-rated properties will be a key factor driving the uptake of CWI and SWI in that sector. For CWI, the majority of the actual uptake will be in the owner occupied sector, but uptake as a proportion of technical potential will be higher in the social and private rented sector.

**Table 11 Uptake of wall insulation by tenure (excluding Affordable Warmth)**

| | Uptake of SWI by 2022 | Uptake as % of SWI technical potential in tenure | Uptake of CWI by 2022 | Uptake as % of CWI technical potential in tenure |
|---|---|---|---|---|
| Social housing | 382,134 | 43% | 637,337 | 59% |
| Private rented | 345,886 | 23% | 328,834 | 40% |

| | | | | |
|---|---|---|---|---|
| Owner occupied | 227,883 | 5% | 1,550,928 | 40% |

## Uptake of insulation measures by house size

148. The uptake of measures across different house size is driven largely by the cost effectiveness of delivering carbon savings. Larger properties consume more energy and, although measures tend to cost more in larger properties, energy savings delivered by installing insulation are typically higher per £ spent. Higher bill savings available to larger properties mean larger amounts of Green Deal finance can be raised, increasing the uptake of measures among these house types. Larger houses also provide more cost effective carbon saving to energy companies seeking to meet the ECO targets, and so received higher subsidies. Flats are also likely to attract significant ECO subsidies, as energy companies seek to benefit from economies of scale resulting from insulating multiple properties at the same time.

**Table 12 Uptake of wall insulation by houses size (excluding Affordable Warmth)**

| | Uptake of SWI by 2022 | Uptake as % of SWI technical potential in house type | Uptake of CWI by 2022 | Uptake as % of CWI technical potential in house type |
|---|---|---|---|---|
| Large detached | 143,777 | 24% | 421,814 | 54% |
| Small detached | 53,090 | 15% | 231,047 | 34% |
| Large semi | 145,464 | 10% | 600,084 | 55% |
| Small semi | 106,612 | 13% | 389,119 | 36% |
| Large terraced | 72,808 | 6% | 171,786 | 45% |
| Small terraced | 64,026 | 7% | 115,649 | 28% |
| Flats | 370,125 | 23% | 587,600 | 43% |

## Impact on Fuel Poverty

149. The impact of Green Deal and ECO on fuel poverty is influenced by whether a household takes up measures and the extent to which the costs of the ECO are recouped from energy bills. Households receiving measures will see their thermal efficiency improve and their risk of fuel poverty reduced. The costs of the ECO are expected to be recouped from energy bills, therefore households not receiving measures will see their risk of fuel poverty increase. In the short run, when delivery of measures is in its early stages and energy bills reflect the costs of the ECO, overall fuel poverty will rise relative to there being no carbon saving obligation in place. However, relative to the costs on existing bills from energy companies' CERT and CESP-compliance, there is likely to be little change. In the longer term the cumulative benefits of the

measures installed under the policy will result in a net reduction in the number of households in fuel poverty.

150. It is challenging to project and quantify the impact of Green Deal and ECO on fuel poverty. In addition to uncertainty about which households take-up which measures, and the costs of delivering them over time, there is uncertainty around changes in the level and distribution of incomes across households, changes to the housing stock independent of the Green Deal and ECO, and energy prices. Based on projected changes in incomes, prices and the housing stock, the measures installed under Green Deal and ECO are estimated to result in a net reduction of between 125,000 – 250,000 households by the time the costs of ECO are no longer passed through to bills in 2023.[73]

## Cost to business

151. The analysis has included a detailed assessment of the costs of the policy package to business. This focuses on the direct costs to business, although many of these costs will be subsequently passed on to consumers (for example, the costs to energy companies of the ECO are likely to be passed on to energy consumers leading to the bill impacts presented in Figure 30) There are several of elements to this analysis

- The ongoing cost to Green Deal providers of running their business. These are based on an initial set up cost of £16 and an annual management cost of £8 per Green Deal. These costs are included in the analysis of the uptake of measures as they affect the amount of Green Deal repayment a provider will charge to consumers. These are broken into two components
    - The direct costs of the Green Deal Finance mechanism itself
    - The wider costs of running the Green Deal provider's business (marketing and sale activities, general business overheads)
- Cost to other businesses of the Green Deal mechanism (including the costs of the accreditation of installers, assessors and products),
- Cost to energy companies of the ECO

152. These costs are set out in Table 13. Not all of these costs are inside the scope of the One In One Out (OIOO) analysis. The costs that are incurred as a result of voluntary activity by businesses are not included in the OIOO, which only focuses on regulatory costs imposed by the legislation on existing businesses (as advised by the Better Regulation Executive).

**Table 13 Cost to business (£m)**

| Cost | NPV | Further Detail |
|---|---|---|

[73] This projected estimate represents a lower estimate than detailed in the consultation impact assessment. This is a result in a change in projection methodology rather than final policy decisions. It is anticipated that estimating the impact using the same methodology would result in the measures modelled in this final impact assessment having a greater impact on reducing fuel poverty in the long run than the set of measures detailed in the consultation stage impact assessment.

| | | | |
|---|---|---|---|
| (1) | Green Deal Provider costs | £670 | |
| (2) | - Of which direct costs of Green Deal finance mechanism | £146 | Table 15 |
| (3) | - Of which other business costs (1 – 2) | £523 | |
| (4) | Costs of Green Deal Finance mechanism to other businesses | £275 | Table 15 |
| (5) | Cost of business (energy companies) of meeting the ECO targets | £10,812 | Table 16 |
| (6) | Cost of business (energy companies) of administering the ECO targets | £17 | Table 17 |
| | | | |
| | Total cost to business | £12,443 | |
| | Total cost to business (excluding ECO) | £1,631 | |
| | Total cost to business of Green Deal mechanism (2 + 4) | £422 | |
| | | | |
| | Total cost to business included in OIOO calculation (non voluntary costs) | £10,963 | |

## One In One Out

### *Introduction/Summary*

153. The cost to business is defined as the direct incremental economic cost to business of complying with new regulation minus the direct incremental economic benefit to business which results from new regulation. Second order costs and benefits are not considered, thus any costs ultimately passed through to consumers remain as costs to business here.

154. The OIOO calculation for Green Deal and for ECO are discussed separately . The Green Deal calculation includes cost and benefits incurred by energy companies, installers and product manufacturers; while the ECO calculation is based on energy companies' costs.

155. The discussion below presents estimates of the direct impact of the Green Deal and the ECO. For Green Deal, an equivalent annualised[74] net cost to business (EANCB) of £7m. For ECO, an EANCB[75] of £1,258m is estimated[76]. This gives a combined Green Deal and ECO EANCB of £1,265m (see Table 14, below).

### *Green Deal cost to business*

156. A full list of Green Deal costs to businesses are included in Table 15 . This section summarises the direct costs for energy companies, Green Deal installers, manufacturers of Green Deal measures in scope for OIOO. The evidence and methodology for these costs can be found in Table 15. Costs incurred by Green Deal providers and advisers are not included in this calculation. This is a conservative omission as these markets will be newly created and voluntary to enter. Firms would only enter the market if they perceived there would be a net positive benefit from entering. Costs that are borne by energy companies but are transferred to Green Deal providers, such as the administration cost to energy companies of Green Deals, are also not included. Table 15 includes a description of which costs are/aren't in scope and why.

157. There will also be considerable net benefits to businesses that take out a Non-domestic Green Deal. The estimated net present value to these businesses is £1.1bn[77] . These costs and benefits are not included in OIOO as businesses are not regulated in the current policy climate to take out Green Deals. These costs and benefits will be fully considered in any forthcoming PRS regulation impact assessment.

158. Table 14, below, shows the cost to businesses, imposed by Green Deal, for OIOO purposes.

### *Energy Company Obligation (ECO) cost to business*

159. The costs of meeting the ECO target that fall on energy companies will be the cost of subsidy given to generate ECO points as well as the costs of administering the scheme. The full details of these costs can be found in section 9.

[74] In accordance with OIOO methodology, the costs and benefits are annualised over the period of costs. This is the sum of the policy length (10 years) plus the length of the longest GDF plan (20 Years). This is 29 years in total as the modelling assumes costs and benefits occur in the beginning of each year.
[75] In accordance with OIOO methodology, the costs and benefits are annualised over the period of the costs of ECO (10 years).
[76] The ECO may yet be classified as imputed taxation by ONS. However, in the absence of such a decision we will continue to treat it as a regulatory measure.
[77] See Table 8 – note Benefits for businesses that take out Green Deals are calculated using the private value of the energy savings rather than the social value, as in the NPV. Costs include installation costs, additional costs, assessment costs and finance costs.

160. The total cost of generating ECO points will be the amount needed to drive householders' demand for installations. This will include contributions to the installation costs, subsidy to overcome demand barriers and hidden costs, and any "additional subsidy" (or rent)[78] accruing to householders or businesses from the market for ECO points. The share of this amount accruing to businesses would be counted as a benefit. However, as the proportion is hard to predict, it has not been included in the above calculation. Had this been included, there would have been some benefits to businesses, and thus a lower net cost to businesses.

161. Table 14, below, shows the cost to businesses imposed by ECO, for OIOO purposes.

**Table 14 Costs to business of Green Deal and ECO for OIOO - £m**

| | | 2012 PV | EANCB |
|---|---|---|---|
| **Green Deal mechanism costs** | | | |
| **Energy Companies** | Changes to energy company internal systems | £15.10 | £0.809 |
| | Central Charge Database | £2.92 | £0.156 |
| | Electricity companies collection and remittance of GD payments | £100.70 | £5.394 |
| **Manufacturers** | Product assurance | £0.56 | £0.030 |
| | Oversight body[79] | £15.59 | £0.835 |
| **GD installers** | Certificate Installers | £0.03 | £0.002 |
| **Total GDM** | | **£134.89** | **£7.226** |
| **ECO costs** | | | |
| **Energy Companies** | Cost of ECO points | £10,811.59 | £1,256.04 |
| | ECO Administrative costs | £16.3 | £1.89 |
| **Total ECO** | | **£10,827.89** | **£1,257.93** |
| **Total costs** | | | |
| **Combined cost of GDM and ECO** | | **£10,962.78** | **£1,265.16** |

[78] See section 9.1 for explanation and more details.
[79] Assumes 1/3 of 47m oversight body charge is paid for by installers

# 8. Green Deal mechanism costs

## Introduction

162. This section sets out the estimated mandated costs associated with the Green Deal framework of advice, accreditation and assurance and the administration of the Green Deal plans. Estimates are derived from discussions with stakeholders and responses to the Green Deal and ECO consultation.

163. For most businesses, participation in the Green Deal market is voluntary. Green Deal Providers, installers and advisers will only participate in the market if the benefits to them from doing so are greater than the costs of complying with the required standards. The mandated costs of the Green Deal mechanism are included in the overall cost benefit analysis for the Green Deal and the ECO for this IA (see section 7).

164. New entrants into the Green Deal market expect a net benefit from participation. Therefore for these businesses the costs are not included in the One In, One Out calculation. However, it does include costs mandated by the Green Deal on existing businesses, for example the costs to Energy Companies to administer Green Deal payments.

165. The consultation set out a preferred policy position for the Green Deal mechanism. In addition, assumptions were made about how the mechanism would function. Annex G discusses areas where evidence gathered through the consultation and further discussions with stakeholders have led to material modifications of proposals[80].

**Table 15 Mandated costs of the Green Deal mechanism**

| Costs | Total cost (NPV, £m) | Who bears the cost | Further detail |
|---|---|---|---|
| **Assessments (all costs outside OIOO, as market entry is voluntary)** | | | |
| Cost of assessments | 1,044 | Domestic: Households | Cost/domestic assessment: £112.50 |
| | 130 | Non-domestic: building owners | Cost/non-domestic assessment: £698 |
| **Consumer protection (in scope of OIOO: Certificate Installers and manufacturers' contribution to product assurance)** | | | |

[80] The response to the consultation can be found on the DECC website http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx

| | | | |
|---|---|---|---|
| Energy Saving Advice Service | 12.1 | Government | |
| Accredit Advice and Installation | 2.8 | Certification bodies | |
| | 0.2 | Government | |
| Adviser training | 10.7 | Advisers | Per domestic adviser: £2,280 to £4,560. Per non-domestic adviser (top up): £1,400 |
| | 0.9 | Government | |
| Certificate Advisers | 26.0 | Advisers | |
| Certificate Installers* | 0.0[81] | Installers | Advisors: annual cost/Installers: de minimis |
| Scope of Green Deal | 0.2 | Government | SI will specify eligible measures |
| Product assurance* | 0.56 | Manufacturers | Test two systems pa/£30,000/test; plus spot-checks |
| | 0.28 | Government | |
| Secondary Disclosure* | 0.0[82] | Competent Person Scheme Operators | For amending electronic notification systems to include Green Deal flag |
| | 0.2 | Government | |
| Addition of measures | 0.1 | Government | 40 work days pa |
| **Provider Mandated Costs (all costs outside OIOO, as market entry is voluntary)** | | | |
| Licensing Fee | - | Government in years 1 and 2, then providers | Cost to be finalised once Oversight Body work concluded |
| Compliance with Consumer Credit Act | 0.15 | Providers | £1,225/provider every 5 years |
| Lodgement and update of EPC register | 7.1 | Providers | Domestic: £1.15 per plan, Non-domestic: £5.36 per plan |
| Energy Company Administration Fee | 137.5 | Providers | 1 pence/plan/day (2p/plan/day for small suppliers |
| Access to Data Transmission Network | 0.3 | Providers | £600 pa per provider |
| **Institutional arrangements (in scope of OIOO: costs for central charge database, systems upgrades, Electricity companies collection and remittance of Green Deal payments and installer's share in oversight body)** | | | |
| Customer statements | 69.9 | Finance Providers[83] | £2/plan pa. £3 on change of ownership |

[81] £29,600, rounded to £0.0m
[82] £35,000, rounded to £0.0m
[83] This could accrue to Green Deal providers depending on the business model.

| | | | |
|---|---|---|---|
| Central Charge Database* | 2.9 | Energy companies | |
| Changes to energy company internal systems* | 15.1 | Energy companies | |
| Electricity companies collection and remittance of Green Deal payments* | 100.7 | Energy companies | |
| Oversight Body * | 46.8 | Providers, Installers, Advisers | £3 m pa until 2042 |
| | 9.2 | Government (years 1 and 2) | |
| Ombudsman Service | 1.3 | Providers | Average Case Fee £330-350 |
| | 0.3 | Government ( first 2 years) | |
| **Total costs summary** | | | |
| Total cost to business (excluding assessments) | 421.9 | | |
| - of which to providers | 146.4 | | |
| - of which: to other businesses | 275.4 | | |
| Total cost to Government | 23.3 | | |
| Total cost of Green Deal mechanism (exc. Assessment costs) | 445.2 | | |
| Total cost of assessment | 1,214.3 | | |
| Total cost of Green Deal mechanism | 1,659.5 | | |

* costs that are in scope for OIOO calculation.

## Assessments

166. Assessments are the gateway to the Green Deal. Many households and businesses can benefit from further clarity on ways to improve the energy efficiency of their property and measures that are suitable. The assessment will provide the estimate of expected energy savings from the installation of energy efficiency measures which will be used by assessors to provide advice to consumers and an indication to Green Deal providers of the maximum amount of Green Deal finance that is likely to be raised. Assessments will be based on an assessment of a dwelling's fabric, using a standardised and impartial tool, as well as an assessment of the occupant's energy demand pattern, to help inform consumer choice.

167. It is estimated that the cost of the fabric component of domestic assessments will be £75, reflecting a slight increase on the current average cost of an Energy Performance Certificate

(EPC). Occupancy assessments are assumed to require between one and two hours, costed at £25/hour, with a central estimate of £37.5[84].

168. Assessments costs for non-domestic dwellings will vary widely given the heterogeneous nature of dwellings, their use and their inhabitants. Cost estimates are assumed to be the average of assessment costs for small, medium, and large buildings.

169. For non-domestic Green Deals an accredited advisor will assess a property with a standard EPC fabric assessment using the existing Simplified Building Energy Model (SBEM) tool and add actual energy-use data and management performance information to provide a modelled estimate of current running costs. They will also be able to draw in specialists for particular elements where necessary. This will enable a bespoke assessment of prospective fuel bill saving.

## Consumer protection

170. The Green Deal includes a number of consumer protection measures which help householders make informed decisions and reduce the risk of sub-standard installations. Consumer protection measures safeguard householders against poor quality workmanship or service at every stage of the customer journey, and thereby support take-up of Green Deal Plans. The following section sets out our consumer protection measures.

171. DECC will fund an Energy Saving Advice Service for three years. This advice service will enable the public to access independent advice on the Green Deal as well as other energy policies such as Feed in Tariffs and the Renewable Heat Incentive. The cost of £12.1 million is based on a projected average of 1.4 million calls per annum.

172. Green Deal customers will be confident that Green Deal assessors and installers have a high standard of competence, with new standards put in place for both, overseen by certification bodies, who themselves must be accredited by UKAS providing for robust quality assurance of the advice and installation services provided under the Green Deal.

173. Advisers will not be certified unless they meet specified training standards set by the National Occupational Standard for Green Deal advisers. Green Deal training costs comprise the additional costs for upgrading skills.[85] Installers will be required to be certified to meet a new installer standard, developed by industry and BSI (PAS 2030). This is largely based on existing standards and has been aligned as far as possible to the DCLG Competent Person's Schemes to minimise costs on businesses.

174. Sitting above this will be the Green Deal Registration and Oversight Body, which will register and authorise assessors, installers and providers. This body will also monitor compliance to the Code of Practice through risk and random based monitoring and in-situ inspections of work, and mystery shopping to test the whole process. Consumer protection has also been strengthened through a revised policy on assessor impartiality and cold calling, as well as

[84] Rate for the equivalent skill set of a Quantity Surveyor, based on the Standard Cost Model
[85] Source: Sector Skills Council

protections for lower than average energy users. Options for disclosure and acknowledgement redress have also been developed, as has the policy on appeals. More detail is set out in the Government Response.

175. Another important part of consumer protection is disclosure. Primary disclosure refers to the fact that as future bill payers will be responsible for paying the Green Deal charge, they need to know about the Green Deal, and its associated charge, before they take the property. Current owners or landlords of the property will be required to disclose the existence of a Green Deal on that property to any potential future bill payer, and to ensure acknowledgement has been obtained by:

- providing potential future bill payers with a full copy of the EPC for that property at the point of viewing the property, or as soon as an offer is made, whichever is earlier; and
- ensuring that any written contract for sale or rent with the new customer includes an acknowledgment that they will be liable for the Green Deal Plan payments and bound by the terms of the Green Deal Plan.

176. For secondary disclosure, a marker will be added to notifications by Competent Person Schemes, in England and Wales, when measures installed are paid for through the Green Deal. These notifications are sent electronically to the local authority and added to a property's building control file. This will be available on the sale of a property through the normal local authority search – and point out the existence of a Green Deal. Secondary disclosure carries a cost for Competent Person Scheme operators who will need to update their systems to add the Green Deal flag notification to their electronic notifications. We expect this to cost in the region of £34,000. There is also a cost to government from secondary disclosure which could be up to £180,000. Both of these are included in the above table.

## Measures

177. The Green Deal assessment is bespoke and takes into account the individual characteristics of the property and its occupants. Our policy is to specify a list of qualifying measures, but not a long list of products that fall within a measure's category. This option has the benefit of setting out clearly the broad scope of the Green Deal but without stifling innovation at the product level. This option will avoid costs associated with creating and maintaining a product list. A statutory instrument will set out the qualifying measures (See Annex J). Following the consultation, the list of eligible measures has been extended from 30 to 45 measures.

178. Products installed with Green Deal finance should be safe, durable and perform as intended. Therefore, there is a need for assurance of product quality as well as performance. The Green Deal Code of Practice will require that all products installed through the Green Deal must meet existing legal obligations such as those set out in Building Regulations and require Conformité Européenne (CE) marking for all products covered by EU legislation. In any event, all products or materials covered by EU legislation relating to CE marking will need to have mandatory CE marking in the UK from summer 2013, therefore the Green Deal does not create additional costs to manufacturers.

179. For measures which consist of a series of components such as external wall insulation, we will require "system testing" to ensure the components work together and certification from a UKAS accredited (or equivalent) facility. This will keep down the cost of warranties and guarantees and also ensure that Green Deal installations meet the standard already being set in the market.

180. We have included a new provision in the Code of Practice to require that Green Deal Providers confirm with their suppliers that the products to be installed in a Green Deal property are a type capable of – or designed to - deliver the level of fuel bill savings estimated for the "measure" during the Green Deal Assessment. This means consumers can be be confident the products installed should deliver the estimated energy savings.

181. The consultation proposed that manufacturers declare in writing their products comply with the Green Deal Code of Practice and register with the Oversight Body. In light of other changes to the Code of Practice and the risk that this approach would contravene EU laws on the requirements to bring construction products to market we have removed this requirement.

182. Spot-checking requirements for products will be combined with the requirement with *in situ* spot checks taking place at the same time as the installation. These will be based on random and risk-based samples.

183. The Green Deal framework should be capable of recognising entirely new measures coming onto the market in an efficient manner. The policy is to use the existing mechanism in SAP and SBEM (Appendix Q) to recognise new measures and add these to the assessment tools and the statutory instrument listing qualifying improvements. The update to the statutory instrument will take place twice a year, rather than annually. This is to enable new measures to be brought to market without having to wait for long periods for this to be legally recognised. Approval and/or appeals process will be created to help administer the process fairly and to review the list.

184. Encouraging innovation in the supply chain is a key policy objective of the Green Deal. Without differentiation between product performance, potentially high performing products may be blocked from being eligible for greater amounts of Green Deal finance. The policy is to use a competitive tender exercise for a contractor to create a process and interface that allows Green Deal suppliers to differentiate the performance of their products. Start-up costs will be funded by the Government. To estimate the cost would prejudice the outcome of the tender exercise. On-going running costs would then be borne by manufacturers, however this process is entirely voluntary.

### Mandated costs for providers

185. The Green Deal provider co-ordinates the Green Deal customer journey – responsible for acquiring customers, directing installers, and offering Green Deal finance. The providers cost of doing business adds to the cost of the Green Deal and the costs that will have to be financed by the householder within the Golden Rule.

186. The majority of provider costs will be balanced by corresponding cost reductions elsewhere in the value chain. For example, search costs for customers shift from installers to providers and so these costs do not increase overall. However some provider costs are additional costs mandated by government.

187. Fulfilment of Consumer Credit Act (CCA) requirements will cost £1,225 for a limited company, payable every five years.

188. Key terms of the plan and other basic information relating to the Green Deal will be added to the EPC by providers who will then have a duty to ensure this updated EPC is lodged on the Landmark Register. The cost for each of two filings (one after assessment and one after inception of the Green Deal plan) is £1.15 and £5.36 for a domestic plan and non-domestic plan, respectively.

189. Providers will pay energy companies an annual administration charge for routing payments to finance providers. The consultation Impact Assessment assumed this fee to be £3 per year. However, in the interest of enabling customer switching of energy provider at any point in time and in order to remove a potential barrier to small energy supplier participation in the Green Deal, it will now be 1p/plan/day, with small energy suppliers receiving 2p/plan/day.

190. Providers will also pay for access to the Data Transmission Network (annual base fee of £480 and an additional variable fee estimated at £120[86]).

191. The consultation proposal was for providers to issue product warranties for the entire repayment period of each Green Deal measure. Although this would provide customers with the greatest certainty that costs will be offset by savings throughout the life of the plan, it added significant costs to many measures. It has been important to strike a balance between ensuring the necessary standards of customer protection whilst not loading disproportionate costs into the mechanism, creating a barrier to uptake and entry into the Green Deal market. Green Deal Providers will now be required to offer product warranties for a mandatory five year period. In addition, Green Deal providers will be required to offer 10 year cover for consequential building damage which may arise as a result of the measures or their installation. These mandatory requirements will apply to all measures except SWI and CWI which will require a 25 year product warranty and 25 years of consequential damage cover. The market already provides cost-effective warranties for these measures and Green Deal Providers could make use of these as part of their customer offer if they meet the requirements in the Code of Practice and Framework Regulations. The range of insurance rates for all measures has not yet been determined. An illustrative cost is based on the projected take-up of boilers.

[86] The variable fee is £2,000/gigabyte.

192. The consultation also proposed that Green Deal providers have a surety bond in place in order to continue to fulfil Green Deal provider obligations in the event of insolvency or loss of authorisation. Feedback from the consultation indicated this would be very costly, especially for smaller Green Deal providers, and may create a barrier to market entry. We will, therefore, remove this obligation and make provision in the Framework Regulations and the Green Deal Arrangements Agreement to ensure that, if the Green Deal Provider ceases to be authorised or is wound up, the most important ongoing obligations of the provider continue to be carried out by the person who is entitled to payments under the plan and customers can still, in appropriate cases, seek redress under the Green Deal legislative framework for failures of the Green Deal Provider (or its assignee). This will reduce costs and barriers for providers wishing to enter the market whilst still ensuring appropriate levels of customer protection.

193. The requirement for Green Deal providers to have an independent conciliation service has been removed. Responses to the consultation suggested this would duplicate the ombudsman functions and add unnecessary cost.

194. Customers will receive an statement of outstanding balance annually and on change of ownership in a dwelling. It is assumed these statements will be issued by finance providers.

## Institutional arrangements

195. Green Deal plan data will be held in a central location accessible to providers. Electricity companies will bear the estimated cost of £2 million (plus running costs) for creating this infrastructure. The cost estimate is based on industry sources.

196. Energy companies will need to adjust their settlement systems for booking householder payments, handling customer queries and managing delinquent debt. Cost estimates are based on stakeholder information and take into account the expected trajectory of Green Deal take-up.

197. An oversight body will authorise Green Deal providers, supervise the Green Deal market and monitor whether the market functions smoothly. The Oversight Body will be outsourced to the private sector through a tendering process to ensure value for money. DECC will fund the Oversight Body's set-up costs and the first two years of running costs. This will encourage early registration by removing costs to entry and allow DECC to monitor performance and establish a level of fees the market might support. The Green Deal Ombudsman will intervene when consumers feel things have gone wrong. Government will pay for the set up costs, and the fixed running costs for the first two years. Any case fees will be paid by Green Deal providers, at the outset. The actual case fees payable by the Green Deal providers will be based on a tiered system and will depend on the complexity of cases.

198. The consultation position was to extend the range of responsibilities of the Energy Ombudsman Service. However, this would have entailed an amendment to primary legislation

which could not have been made in time for when the Green Deal framework becomes operational. Therefore it has been decided to create a dedicated Green Deal ombudsman.

## Green Deal charge

199. The consultation asked about the desired level of flexibilities in Green Deal interest rate structures in the domestic sector. A review of consultation responses has led to rejecting the option of permitting indexed linked interest rates because an overwhelming majority of respondents preferred the simplicity of a fixed rate deal.

200. Therefore Green Deal providers will be limited to only offering Green Deal plans with a fixed interest rate to domestic customers. However, in order to capitalise on some of the expected increase in savings, providers will have an option to uplift the charge by 2% each year. If Green Deal providers choose to utilise the 2% uplift, the instalments under the Green Deal plan will still be fixed at the outset. This provides customers with certainty regarding their payments whilst enabling more measures to meet the Golden Rule, because the total amount of finance initially offered will be greater. (see annex G for further detail). The same restrictions will not apply to non-domestic Green Deal plans.

# 9. ECO mechanism costs

201. This section provides an assessment of the costs of the ECO, and an explanation of the distributional implications of a supplier obligation. The cost estimates presented here are those that are additional to the Green Deal Mechanism costs described in section 8 and are reflected in the overall cost benefit analysis presented in the Aggregate Impacts section.

## 9.1 ECO points

202. The installation of energy efficiency or heating measures which are within the scope of the carbon targets or the Affordable Warmth target will generate credits, or 'ECO points' (see Annex H for ECO eligible measures and target metrics). Energy suppliers must obtain sufficient ECO points to meet their obligations. Suppliers will be able to generate ECO points through their own installation activities. However, it is expected that, as with previous obligations[87], there will be a market for ECO points where suppliers contract with installers for ECO points. A further consultation on the ways in which ECO brokerage could be used to help the market to develop efficiency will be undertaken in Summer 2012.

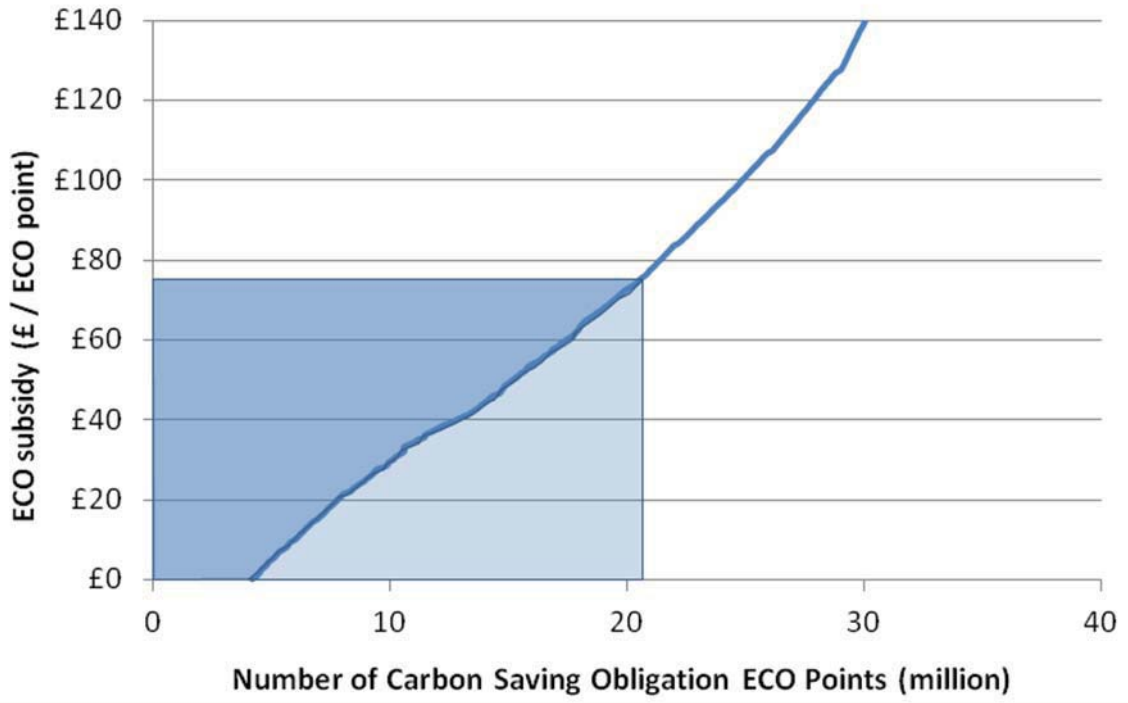
203. Placing an obligation on energy companies to deliver ECO points creates a demand. The market demand for points will be fixed at the level of the ECO target and will be perfectly inelastic. That is, energy companies will be willing to pay any reasonable price to generate or buy ECO points in order to avoid the cost of a penalty for not meeting their obligation.

204. The market supply curve for ECO points represents the relationship between the number of ECO points and the marginal subsidy required per ECO point to create demand for the measures that generate them. Some measures can generate ECO points at low cost in receptive households. However, the more ECO points that must be generated, the more that either higher cost measures or measures for which there is greater consumer aversion will have to be installed (or both). The upward slope of the ECO point supply curve (see Figure 33) reflects the increasing requirement for subsidy to persuade households to install measures as carbon savings ambition increases. The curve reflects amongst other factors, consumer differences in willingness to pay for identical measures, differences in cost-effective ECO point potential across houses, and differences in suppliers' costs of installing identical measures.

205. The marginal cost to installers or suppliers of generating an ECO point is determined by the intersection of the supply and demand curves for ECO points. The subsidy required to deliver the last ECO point should determine the market clearing price for all ECO points. The brokerage should provide a transparent signal to market participants of the marginal cost of generating ECO points.

[87] Evaluation synthesis of energy supplier obligation policies, DECC, 2011, http://www.decc.gov.uk/assets/decc/11/funding-support/3340-evaluation-synthesis-of-energy-supplier-obligation.pdf

Figure 33 Central scenario ECO point supply curve and the cost of ECO (for first interim period)




206. For the energy suppliers, the total cost of the ECO is the size of the obligation (the total number of ECO points) times the market clearing price for ECO points (marginal subsidy cost (£/ECO point) of the last unit of carbon abatement) This is represented by the shaded blue rectangle in Figure 33). These costs will either be the costs of contracting for ECO points through the brokerage or the subsidy cost of promoting and installing the measures through their own activities. The costs of the ECO to suppliers, in the Aggregates Impact section are calculated in this way.

207. The ECO obligations are quantity targets, requiring a given level of savings to be achieved. Until the ECO becomes operational there is uncertainty over what the market clearing price will be. The price will be determined by a range of factors including fossil fuel prices, technology costs and consumer preferences. In the different modelling scenarios the costs to energy suppliers of meeting the obligations varies, this is explored in more detail in the Aggregate Impacts section. The costs to energy suppliers, under central assumptions are shown in Table 16 below.

Table 16 ECO costs of driving installations

| **ECO costs to energy suppliers of driving uptake of measures**[88] | |
|---|---|
| ECO Carbon Savings targets, of which: | £950m p.a. |
| *Carbon Saving Obligation* | *£760m p.a.* |
| *Carbon Saving Communities (including Rural Safeguard)* | *£190m p.a.* |
| ECO Affordable Warmth obligation | £350m p.a. |

[88] Including contribution to the installation costs, subsidies to overcome demand barriers and hidden costs

208. In a competitive installation market, households are aware of the value of the ECO points generated by installing their measures in their homes and installers compete for work. Under these conditions, the value of the ECO points should be passed through to householders as subsidy. Those householders who are most willing to install measures, or who have some of the most cost-effective potential (positioned left on the ECO point supply curve in Figure 33) would have required no or little minimum amount of subsidy to be persuaded to install a measure. The subsidy they actually would receive could be greater, however. These householders can capture some additional subsidy *above* their reservation subsidy level up to the ECO point market clearing price. For some of the most cost-effective measures, the subsidy offered is expected to exceed 100% of the installation cost.

209. In this competitive installation market, the darker shaded triangle areas in Figure 33 illustrates the ECO subsidies that are given to householders that exceed their reservation subsidy levels. The more the marginal cost of meeting the ECO target increases, the greater this proportion of the ECO subsidy that will be ”additional subsidy” above these reservation levels.

210. In some instances, installers may be able to generate demand for ECO measures while offering a subsidy below the market’s marginal subsidy rate. This is most likely where householders do not get multiple quotes for installing measures. In these instances installers will capture some of the additional subsidy for the ECO points the installations generate. While it is likely that this will happen to some extent, and that it would reduce the cost to business of the ECO, a conservative assumption has been made for the OIOO calculations that all the additional subsidy is passed through to householders.

### Cost pass through

211. In a competitive market, it is profit maximising for the energy suppliers to charge all their customers the marginal cost of supply. The ECO will impose costs on suppliers to meet the obligation. These costs increase the marginal cost of companies to supplying a customer with energy. The cost to companies of supplying a unit of energy will be increased by the marginal cost of generating the ECO points that a suppliers’ ECO obligation is increased by for each KWh they supply.

212. Companies pricing decisions and pass-through of costs are commercial decisions. In the absence of evidence from companies on their pricing behaviour, it is assumed that energy suppliers will pass through the full cost of meeting the obligation to their consumers. DECC has anecdotal evidence to suggest that energy companies do this. They cost environmental policies at marginal cost, and fully pass through the cost of policies. There are no qualitative reasons to suggest why companies will not treat environmental costs in the same way as any other cost of production in this respect.

## Administrative costs

213. Energy suppliers will face administrative costs associated with the ECO, over and above the administrative burden of the Green Deal. Suppliers will need to have the staff as well as monitoring and reporting structures in place to comply with the obligation, and familiarise themselves with the obligation. These costs are discussed below.

Table 17 Estimated ECO administrative costs to energy suppliers

| **ECO administrative costs to energy suppliers (PV)** | |
|---|---|
| **Carbon obligations** | |
| Monitoring/reporting set up costs | £27,000 |
| Familiarisation costs | £16,000 |
| Recurring administration costs | £890,000 |
| **Affordable Warmth obligation** | |
| Fixed costs | £7.9m |
| Variable costs | £7.4m |
| ***Total ECO administrative costs*** | ***£16.3m*** |

214. Energy companies are reluctant to provide estimates of administrative costs associated with supplier obligations for commercial reasons. Evaluation of existing supplier policies like CERT and CESP, and the Green Deal and ECO consultation, have provided little guidance as to what these costs are. The estimated admin costs presented here are therefore uncertain, but guided by costs reported by of the administration of other schemes and informed by engagement with energy suppliers.

215. Energy suppliers are likely to incur one-off costs associated with changes to e.g. **reporting requirements under ECO** from existing schemes, for example by investing in new software. The exact amount will depend on the ECO administrators reporting requirements, but is expected to be modest given that the obligated suppliers will have existing reporting requirements under the CERT extension. The set up cost is estimated at around £27,000[89].

216. Suppliers will also face a one-off cost associated with time spent on **familiarisation** with the ECO scheme. This is likely to include time spent for employees to understand the new framework, and explain this to the companies' senior directors. The prior existence of CERT and CESP is likely to mean that this cost is relatively modest, and is estimated at around £16,000 for the obligated companies[90].

217. There are likely to be **recurring administration costs** associated with reporting and all other administration activities associated with the carbon targets. The reporting requirements of ECO has not yet been determined, therefore these costs are uncertain. It has been assumed that the estimated annual reporting costs are similar to those assumed under CERT, at around

[89] This is calculated as 25% of the annual administrative costs of around £107,000, in accordance with the Standard Cost Model guidance.

[90] It is assumed that each obligated company will require eight person days at a cost of £336 per day. This estimate represents the approximate value of management time and associated overheads (Standard Cost Model wage code 111). £336 per day *8 days*6 companies =£16,128.

£64,000 per year[91]. Beyond the reporting costs, it is assumed that there will be admin costs of three employees per obligated company, who will take fifteen days per year to undertake administrative duties associated with the targets at an hourly rate of around £21. This adds an extra £43,000 per year, giving a total annual administrative cost of £107,000 per year. This gives a present value of around £890,000.Companies could choose to meet their obligation by trading on the brokerage, contracting with external providers or promoting the delivery of measures through their own delivery arms. The cost to companies of providing subsidies to deliver measures is captured in Table 16 above. Companies could incur some overhead costs if they contract ECO delivery out of house. However, these costs are expected to be outweighed by the benefits to them if they chose to deliver their obligation through this route. Government will be seeking evidence on the costs and benefits of an ECO brokerage platform in a Summer 2012 consultation.

218. Energy Companies would also incur administration costs for the **Affordable Warmth** target. These are estimated in two components: a) a fixed time cost for participating energy suppliers associated with managing and administering the installation of measures to achieve the target; and b) a variable cost associated with handling phone calls from householders identifying themselves as eligible for assistance under the target and verifying these households.

219. The fixed time cost component is calculated by taking an estimated profile of staff members required to administer achievement of each participating supplier's target, and applying indicative salary rates to each member in order to estimate the opportunity cost of their time. On average this is equivalent to just under 4 Full Time Equivalents (FTEs) per participating supplier, per year of the scheme, valued at a weighted average salary cost of circa £38,000 per FTE. This results in an estimated annual time cost across all participating suppliers of £910,000 per year. In the first year of the scheme only, additional setup time costs are also calculated, in the same way, by taking an estimated 1 FTE and valuing the time with a weighted average value of circa £70,000 per FTE. This results in an estimated one-off setup cost across all participating suppliers of £385,000. The present value of the fixed element is £7.9m.

220. The variable cost associated with phone calls is estimated by applying estimated time and resource costs of processing a phone call to the total number of measures that are estimated to be installed in each year of the scheme under the Affordable Warmth target. 30% of these phone calls are also assumed to require a follow up call. The capital costs of running a call centre are assumed to already have been incurred, and are therefore sunk costs that are not attributable to the ECO. Under the central working option, around 105,000 households are estimated to have measures installed on average in each year of the scheme (adjusted to account for some households potentially receiving more than one measure). Applying a 30% uplift results in an estimated 135,000 phone calls per year, which are then valued using an average cost of £7 per phone call.[92] This results in an average annual cost of handling phone calls of around £1m across all participating suppliers per year giving a present value of £7.4m.

[91] £59,000 per year (2009 prices) reporting costs assumed in the CERT assessment http://www.decc.gov.uk/assets/decc/consultations/certextension/121-iacertextension.pdf

[92] Cost estimate based on previous experience of schemes targeted at low income and vulnerable households.

## Costs of the ECO administrator

221. There will be costs to Government associated with the ECO administrator, however, the final arrangement and appointment of the administrator is yet to be confirmed and we therefore do not have actual cost estimates. For the purpose of this assessment, it is estimated that there will be a one-off cost of around £1.3m associated with setting up the ECO administrator, and that the administrator's annual operating costs will be around £2.5m per year. The set-up costs are based on cost estimates of setting up CESP, and the operating costs is the estimated combined cost of operating the CERT and CESP.

**Table 18 ECO administration costs to Government**

| **ECO costs to Government – administration (PV)** | |
|---|---|
| **ECO administration** | |
| Set-up costs | £1.3m |
| Operating costs | £20.8m |
| ***Total cost to government*** | ***£22.1m*** |

222. Costs to government of the brokerage administrator will be assessed in the Summer 2012 brokerage consultation.

# 10. Wider Impacts

## 10.1 Health impacts

223. Living in cold conditions is linked to a number of detrimental physical and mental health impacts. A number of studies have concluded that inadequate levels of heating and other factors associated with fuel poverty are linked, in particular, to respiratory problems in children and an increased risk of mortality in older adults.[93] Other sources also highlight the risk of respiratory problems among adults and the potential development of influenza, pneumonia and asthma, alongside an increased risk of arthritis and accidents at home linked to poorly heated housing.[94]

224. However, there has also been some recent discussion suggesting that the reduction in permeability in homes could lead to higher levels of toxic particles in the home.[95] This could have long term negative health impacts, for example lung cancer (radon), stroke or heart attacks (second hand smoke) and respiratory illness for children (mould). This potential impact on health as a result of energy efficiency measures has had limited discussion to date, but the current evidence suggests that the majority of the impact can be resolved by ensuring that alternative forms of ventilation are installed alongside energy efficiency measures to create the appropriate level of permeability in the home.

225. Specific targeting of measures at low income and vulnerable groups would be expected to have a greater health impact, as these groups are more likely to under-heat their homes and/or be more susceptible to the negative health consequences of living in low temperatures. The greater ability of households to adequately heat their homes, while also reducing the amount of energy needed to do so, is likely to result in a number of households increasing the average temperature in their homes. It is expected that this would reduce the risk of the health impacts of living in cold homes and poor housing conditions.

226. Estimating the precise health impact of installing heating and insulation measures is problematic due to uncertainties around which households will receive a measure(s), how their use of energy will change as a result, and the condition of the property they live in. As a result, there is currently no set methodology for estimating and attributing health impacts of the installation of heating and energy efficiency measures, and any resulting increase in indoor

[93] For example, Green, G. and Gilbertson, J. (2008). *Warm Front Better Health: Health Impact Evaluation of the Warm Front Scheme*. CRESR; Wilkinson, P. et al (2001). *Cold Comfort: the social and environmental determinants of excess winter deaths in England, 1986-96*. Policy Press; The Eurowinter Group (1997). Cold exposure and winter mortality from ischaematic heart disease, cerebrovascular disease, respiratory disease, and all causes in warm and cold regions of Europe. *The Lancet*, 349, 1341-1346.

[94] Liddell, C. and Morris, C. (2010).Fuel Poverty and Human Health: A Review of Recent Evidence'. *Energy Policy*, 38(6), 2987-2997.

[95] Wilkinson, P. et al (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: household energy. *The Lancet*, 374(9705), 1917-1929.

temperatures. Consequently, it has not been possible to estimate the impact of the Green Deal and ECO at present.

227. DECC is currently developing a model which aims to estimate the mortality, morbidity and mental health impacts associated with heating and energy efficiency measures. This area of analysis is still in development and therefore it has not been possible to generate estimates of health impacts of the policies at this stage.

## 10.2 Sustainability

228. The idea of sustainability is for the current generation to live within its means, so that the well being of future generations is not negatively affected by its actions. A key aim of the Green Deal is to reduce energy consumption in order to meet the UK's Carbon Budgets, which set a ceiling on the amount of GHGs emitted during each five-yearly budget period to 2050. The benefits of this should help address dangerous climate change, which would affect future generations disproportionately.

229. Other sustainability benefits of the policy would be a reduction in the use of non-renewable inputs in the energy generation process and gas supply, and less water usage in the generation of steam for electricity generation. These benefits have not been quantified in this IA and have thus conservatively been omitted from the cost benefit analysis.

## 10.3 Equality impact assessment

230. This section of the IA provides an assessment of the Green Deal and ECO policy against the protected characteristics of age, disability, gender, gender-reassignment, marriage and civil partnerships, pregnancy and maternity, race, religion or belief and sexual orientation, as specified in the Equality Act 2010, and outlines where changes have been made to ensure all opportunities to promote equality are taken. Where a particular protected characteristic is not listed below for a policy sub-heading, it is because there is no evidence that people with this protected characteristics are more or less likely to benefit from the policy or are discriminated against by the policy.

### Impact of Green Deal on protected groups

231. The Green Deal will be available to all householders provided they are connected to the electricity grid. The Green Deal will not discriminate against any of the protected groups covered by the Act. All Green Deal customers will have an assessment of their property carried out first in order to determine which energy efficiency measures are appropriate for them before any finance arrangements can be taken out. Customers will be free to use the Green Deal assessment and shop around for the best deal from a Green Deal provider.

#### *Age and disability*

232. The Government will introduce the Energy Saving Advice Service (ESAS) to ensure that all potential Green Deal customers have access to a source of impartial advice. The ESAS contract requires telephone, email and digital functions to be an accessible service for all customer journeys and that resources should be supplied in accessible formats e.g. Braille and large print. The decision to have a telephone helpline could be particularly important for the

disabled on low incomes unable to operate or install the internet, or for older people as adults aged 65 and over make up almost two-thirds of those individuals who have never accessed the Internet.

### *Religion or belief*

233. If the Green Deal charge has interest added to payments then this could potentially have an impact on some religious groups, such as the Muslim community, who do not want to handle interest payments since it may be prohibited by their faith. However, the repayment structure for the Green Deal is for the market to configure within the constraints of the legislation, the legislation does not require the payment of interest as part of the repayments. The flexibility built into the legislation will allow Green Deal providers to develop products, and repayment structures, to suit the needs of different customers. If there is a market for this it is likely to include Sharia compliant products. Providing a Green Deal product in line with such principles might increase costs to Green Deal providers, which could be passed on to these, and other, customers.

## Impact of Affordable Warmth (AW) obligation on protected groups

234. The AW obligation will be focussed on the vulnerable and low-income and will have specific eligibility criteria. Its purpose would be to ensure help is available to those who most need assistance to reduce the cost of heating their homes, and to those who might not achieve significant energy savings and are therefore unlikely to take up Green Deal finance.

### *Age*

235. The AW obligation is expected to have a positive impact on some age groups, and a potentially negative impact on others. The eligibility criteria for AW support has been expanded following the consultation. Households which include a person receiving working tax credit and qualifying element, or child tax credit with a household income lower than £15.860k, pension credit or one of the eligible means tested benefits and qualifying criteria (including those with a child under 16 years old or 19 years old or under in full time education), will be eligible for AW support. Households that are not eligible for AW will not receive measures but would face the costs associated with meeting the obligation which will be passed on by energy suppliers.

### *Disability*

236. The AW obligation is expected to have a positive impact on disabled people who are on low incomes. Households with an occupant in receipt of both disability and income related benefits will be eligible for affordable warmth support. On the other hand those with a disability who do not claim income related benefits will not be eligible for AW support but still face the costs of ECO that are passed on through energy bills.

### *Pregnancy and Maternity*

237. The AW target is expected to have a positive impact of recent mothers on low incomes. Households on income related benefits with a child under 16 or in full time education up to the age of 19 will be eligible for affordable warmth support, and so will be proportionately more likely to benefit.

### Impacts of Carbon Saving Obligation on protected groups

238. The Carbon Saving Obligation is not expected to discriminate against any group, although some groups may be more likely to receive support than others. For example, as illustrated in Table 19 below, households with one occupant over 65 years old or with a disability could be slightly less likely to benefit from the obligation given its focus on insulating solid wall and hard to treat cavity wall properties. However, there are a wide range of other factors that will affect uptake of energy efficiency measures.

**Table 19 Number of households with at least one occupant over the age of 65years and over, 5 years old and under or with a disability in a solid wall or cavity wall property[96]**

| | Cavity with insulation (thousands) | Cavity uninsulated (thousands) | Solid walled property (thousands) | Total |
|---|---|---|---|---|
| **Total number of households in England** | 7,417 (33% of total) | 8,073 (37%) | 6,748 (30%) | 22,238 |
| **65 years and over** | 2,594 (44%) | 1,866 (31%) | 1,453 (25%) | 5,913 |
| **5 years old and under** | 758 (29%) | 995 (38%) | 862 (33%) | 2,615 |
| **HRP or partner registered disabled** | 913 (48%) | 526 (27%) | 473 (25%) | 1,912 |

## 10.4 Rural Impacts

239. DECC is committed to considering the impact to rural people and places in developing and implementing fair and effective policies. The Green Deal and ECO have primarily been designed to incentivise Energy suppliers and the Green Deal market to install energy efficiency measures where it is most cost effective for society. Consideration of the rural impacts of the Green Deal and ECO will be an ongoing process and will not stop at the policy design stage. The evaluation strategy will also seek to ensure the policy is effective in rural areas.

240. Installation costs are, on average, likely to be higher in rural locations[97] because the properties are often hard to treat and more dispersed, with less opportunity for benefiting from economies of scale. Many (38% of the 4m) [98] rural properties are off gas grid, though, which will typically increase the bill and carbon savings from installing measures in them. This

[96] Energy use in English homes 2011

[97] However, it should be noted that some urban areas, such as central London, also have many hard to treat properties.

[98] English Housing Survey: Housing Stock Summary Statistics 2009 (http://www.communities.gov.uk/documents/statistics/pdf/19372481.pdf)

improves the cost-effectiveness of installations, and therefore increases the likelihood that these properties will be targeted as part of a least cost way to meet the ECO obligations. Alongside this natural incentive to target off grid gas properties, suppliers will be required to deliver 15% of their CSC target to low income rural households.

241. A high proportion of rural properties are harder to treat (29% SWI, 20% HTT CWI)[99]. ECO will focus on these hard to treat measures so more installations in rural locations are expected than under previous policies. The policy has also been designed to increase the take up of cost-effective rural opportunities. For example, the trading of points through the ECO brokerage should make it easier for local installers in rural locations to gain access to ECO subsidy.

242. Around half of the cost of the ECO are likely to be passed on to consumers through gas bills, so rural properties that are not connected to the gas grid will experience less impact to their total energy bill as a direct result of ECO.

## 10.5 Competition impact assessment

243. The Green Deal and ECO policy introduces a new market mechanism for the installation of energy efficiency measures in which competition will play a central role. This section of the IA provides an assessment of the overall impact on competition of the policy in accordance with OFT guidance[100].

### Does the policy directly limit the number or range of suppliers?

244. The Green Deal legislation will affect the range of suppliers competing in the market through the creation of The Green Deal Finance Company, the accreditation process and the possibility of social housing providers becoming Green Deal providers.

*Green Deal finance Aggregator*

245. One of the most effective ways to reduce the cost of capital to the Green Deal Providers who will provide finance to consumers is through the creation of a financing/ aggregation vehicle that would achieve enough scale to access the cheapest available funds on the capital markets. We are aware of at least one private sector led organisation with significantly advanced plans to do this. It could be argued that the creation of one special purpose vehicle to serve the majority of the provider market would potentially limit competition and possibly reduce financial innovation. However, without a central vehicle to aggregate Green Deals and achieve the scale required to access the capital markets, it is likely that competition in the provider market would suffer . Providers would have to develop their own finance solutions, or carry the liability on their own balance sheets. This is something that smaller and medium-sized providers in particular may find it difficult to do.

*Accreditation of assessors, installers and products*

246. The accreditation of advisors, installers and products will not substantially extend the level of accreditation developed and adhered to by industry, but consolidates the requirements and standardises accreditation, strengthening consumer confidence in the sector. For example:

[99] English Housing Survey: Housing Stock Summary Statistics 2009 (http://www.communities.gov.uk/documents/statistics/pdf/19372481.pdf)
[100] See http://www.oft.gov.uk/shared_oft/reports/comp_policy/oft876.pdf

- There is already a competitive market for assessors of domestic buildings created through the implementation of the EPC which the Green Deal draws on;
- A number of installer certification bodies already exist as a form of self regulation to overcome adverse selection problems in the market; and
- Accreditation requirements for products will largely draw on requirements set out in building regulations or EU legislation which suppliers are familiar with.

247. Only accredited Green Deal advisors and installers are able to participate in the scheme. Whilst this will limit who can supply the market, there is still likely to be a sufficient number of companies for the markets to be competitive. DECC will be fully funding the oversight body in years 1 and 2. This will remove additional oversight registration costs for business in the first two years while the market establishes and allows businesses to assess the actual costs and benefits from joining. For the product market, the targeting of the ECO may distort the market as products which do not receive ECO support will look less attractive to Green Deal customers. However, there is likely to be a sufficient number of suppliers of each type of measure for the market to remain competitive.

### Does the policy indirectly limit the number or range of suppliers?

248. The Green Deal could indirectly limit the number of suppliers if its costs affect some suppliers more than others. Imposing higher fixed costs relative to variable costs increase the economies of scale for those operating in the market, which places smaller firms at a disadvantage.

#### *Green Deal Providers*

249. The overriding constraint on an organisation becoming a Green Deal provider is the ability to access and structure long term finance to fund the installation of measures, or to hold Green Deal finance plans on their balance sheet. There a number of other requirements on Green Deal providers, the overhead costs of which increase could place smaller firms at a competitive disadvantage.

250. Given that a large number of expensive measures such as SWI require ECO subsidy as well as Green Deal finance, the small number of energy suppliers who will be responsible for meeting the ECO could have a large influence on the Green Deal and ECO market. For example, many energy companies are expected to become Green Deal providers, and could choose to channel ECO subsidy through their own Green Deal provider business. If other Green Deal providers are unable to access and channel ECO subsidy to their customers they will be at a competitive disadvantage. A further consultation on a brokerage platform to open up the market for ECO subsidy will be published in Summer 2012.

#### *Energy supply market*

251. Under the Green Deal, smaller energy suppliers are able to choose whether to opt into the repayment collection system. This gives small firms the opportunity to avoid the costs of the system, which might place them at a competitive disadvantage because of the fixed costs of establishing systems for administering repayments. Those that choose to opt out would be unable to supply energy to Green Deal customers. However, the fact that firms are able to

choose whether to be part of the Green Deal system means competition in the energy market is unlikely to be affected.

252. Smaller suppliers (fewer than 250,000 customers) are exempt from having to participate in the ECO and the obligation will be tapered for smaller suppliers who pass through the 250,000 customer account threshold. This will reduce the barrier to growth associated with the current supplier obligations whereby a smaller supplier passing through the threshold is required to meet an obligation equal to their total market share.

*Assessment markets*

253. Green Deal providers may choose to employ authorised energy advisors to carry out Green Deal assessments for potential customers. Qualified and authorised advisors will be required to inform customers if they work for a Green Deal provider before they carry out an assessment, so the consumer is aware before the visit takes place. The assessment and recommendations will be produced using the approved methodologies and the outputs recorded for quality assurance purposes. Customers would also be free to use a Green Deal assessment to shop around for the best deal. These requirements would maintain competitive pressure in the market.

*Energy Service Contract and Energy Performance Contract suppliers*

254. Green Deal providers will provide some of the measures that are currently supplied by Energy Service Companies (ESCs) and Energy Performance Contract (EPCs) suppliers. The benefits to Green Deal providers of the Green Deal accreditation schemes and their ability to attach repayment plans to electricity meters could place them at a competitive advantage to ESCs and EPCs. However, these firms would be able to become Green Deal providers themselves and will continue to provide a range of energy management services not available from Green Deal providers. Commercial organisations are therefore likely to continue to see the benefits of employing ESCs and EPCs to manage their energy use.

### Does the policy limit the ability of suppliers to compete?

255. Some aspects of the Green Deal legislation raises the costs of innovation and so reduces their ability to compete. However the net effect on innovation, and competition, in the market is expected to be positive.

*Energy efficient product market*

256. New products that deliver higher energy savings need to go through an assessment process before their superior quality can be accounted for in repayment calculations. The product assessment procedure includes a process for fast tracking new products to reduce costs to suppliers. New products that do not fall into the broad categories of measures used in the SAP have to go through a testing process. This can cost around £25,000-£30,000 and take 6-12 months. New SWI systems are likely to need to go thought this process.

257. The need for products to undergo assessment to gain the benefits of better performance, and the need for new measures to be included in the SAP, increases the costs of bringing new products to market. Higher innovation costs reduces competitive pressure in the market.

However, overall the Green Deal encourages innovation in the sector by increasing the size of the market.

### Does the policy reduce suppliers' incentives to compete vigorously?

258. The Green Deal legislation would not reduce suppliers' incentive to compete.

*Energy suppliers*

259. Energy companies are likely to be able to pass on the costs of the ECO to energy consumers. An energy company with higher prices than its rivals will lose market share as customers switch to other suppliers. Energy companies therefore have a strong incentive to keep the costs of their obligations as low as possible in order to minimise the impact on energy prices.

260. Collection of Green Deal repayments through energy bills requires an additional process to be in place to manage a consumer switching from one supplier to another. This is done automatically by the energy suppliers concerned, using the customer switching processes already in place so is not expected to affect their ability or incentive to switch energy supplier.

*Green Deal Provider market*

261. The information energy companies hold about their customer may give them a competitive advantage in the provision of Green Deal plans. The legislation therefore provides powers for generic promotion of the Green Deal by all energy companies, which should reduce this competitive advantage. In addition, other Green Deal providers are expected to develop customer acquisition processes, such as cross-selling Green Deal plans with other renovation work.

### Small Firms Impact Assessment

262. The assessment above identifies the key competition impacts on small firms and how the Green Deal and ECO have been designed to facilitate, as much as reasonably possible, entry of small firms. There are some design aspects which will limit a small firms ability to compete, but these have been introduced to ensure the policy meets its central aims, as set out in section 3.

### Microbusiness exemption

263. As noted above, the close integration of the ECO and Green Deal Finance create a clear rationale for adopting the same standards of certification for participants in both schemes. To this end, we will require all ECO installers to comply with the Green Deal Code of Practice and the relevant requirements set out in the Publicly Available Specification 2030 (PAS 2030).

264. In practice, the certification requirements for installers under the ECO and Green Deal will broadly mirror those of the CERT and CESP schemes. The only additional requirement on businesses will be to read the relevant sections of the Code of Practice and to subscribe to PAS 2030. These costs are captured in Table 15 which covers all costs associated with the Code of Practice and other accreditation requirements). In total, it is estimated that the new requirements could lead to a modest one-off cost to microbusinesses of £75 per CWI and SWI installer. This equates to a total cost of £15,375 across all 205 microbusiness installers[101] . It is

[101] This is based on figures provided by stakeholders that there is likely to be around 60 SWI installers operating under Green Deal and ECO, of which 40 will be microbusinesses, and 205 CWI installers, of which 165 will be microbusinesses.

also important to note that, as the number of remaining unfilled lofts and wall cavities diminishes, companies should naturally begin to diversify into other areas of the energy efficiency market.

265. The estimated costs are small in comparison to the size of risks they mitigate and the overall importance of the accreditation framework to Green Deal. Consumer confidence in the Green Deal will be vital if it is to encourage significant take-up of energy-efficiency retrofitting. A strong accreditation framework will help ensure that consumers can have confidence in the products and services they receive without worrying about the risks of rogue businesses. This view is reinforced by the lessons learnt from insulation delivery programmes in Australia, where poor quality installations led to fires and serious injuries.

# 11. Glossary of Abbreviations and Acronyms

| | |
|---|---|
| AW | Affordable Warmth obligation |
| BAU | Business As Usual |
| CERT | Carbon Emissions Reduction Target |
| CESP | Community Energy Saving Programme |
| $CO_2$ | Carbon Dioxide |
| $CO_2e$ | Carbon Dioxide equivalent |
| CS | Carbon Saving obligation |
| CSC | Carbon Saving Communities obligation |
| CWI | Cavity Wall Insulation |
| DECC | Department of Energy and Climate Change |
| ECO | Energy Company Obligation |
| EPC | Energy Performance Certificate |
| GDF | Green Deal Finance |
| ETT CWI | Easy to Treat CWI |
| HTT CWI | Hard to Treat CWI |
| IA | Impact Assessment |
| LI | Loft Insulation |
| MACC | Marginal Abatement Cost Curve |
| NPV | Net Present Value |
| PRS | Private Rental Sector |
| RdSAP | Reduced Data Standard Assessment Procedure |
| SAP | Standard Assessment Procedure |
| SBEM | Simplified Building Energy Model |
| SWI | Solid Wall Insulation |

# Annexes

## Table of Contents

# Annex A: Analytical Assumptions

This annex sets out all the analytical assumptions used in the domestic and non-domestic modelling including energy savings from measures, technical potential, costs and carbon intensity.

## Green Deal Household Model Inputs

### Technical Potential

*Technical potential* is the number of houses in GB where it is seems technically possible to install measures. Published DECC energy efficiency statistics were used to estimate the remaining potential in September 2011. From these numbers, the likely activity in the Carbon Emissions Reduction Target (CERT) was subtracted to give an estimate for the start of 2013. CERT activity was estimated using the Final Option illustrative mix from the June 2011 Impact Assessment on the exclusion of electronics and appliances from the CERT extension. It was assumed that CERT extension activity was likely to have commenced after October 2010.

Table 20 summarises the estimated outstanding carbon abatement potential as of 2013, assuming there is no abatement activity during this period. This table is consistent with the 2013 MACC chart in chapter 5 of the main IA report.

**Table 20: Breakdown of carbon abatement by measure**

| Measure | Abatement Potential ($MtCO_2$) | % of total |
|---|---|---|
| Solid wall insulation | 5.7 | 60 |
| Cavity wall insulation (hard to treat) | 1.5 | 16 |
| Cavity wall insulation (easy to treat) | 1.2 | 12 |
| Loft insulation (top-up, stand-alone) | 0.2 | 3 |
| Loft insulation (top-up, with package) | 0.8 | 9 |

### *Cavity Wall Insulation (CWI)*

Cavity walls have been divided into two types based on the cost of insulating them to the required standard; 'easy-to-treat' (ETT) and 'hard-to-treat' (HTT). The exact split between ETT and HTT is unknown. However, some of the features of a wall that are likely to lead it to being more expensive to treat are easily identifiable through a standard Green Deal assessment.

The HTT cavities have therefore been divided in two groups; identifiable and unidentifiable. Identifiable HTT cavities have features that clearly separate them from other type of cavities, making it practical for ECO subsidies to be targeted at them. Estimates of the number of each type of cavity are based on research by Inbuilt and are summarised in the tables below.

**Table 21 Technical potential for CWI by house type (thousands)**

| | Easy to treat | Hard to treat unidentifiable | Hard to treat identifiable | Total |
|---|---|---|---|---|
| Large detached house | 296 | 44 | 442 | 782 |

| | Easy to treat | Hard to treat unidentifiable | Hard to treat identifiable | Total |
|---|---|---|---|---|
| Small detached house | 256 | 38 | 382 | 676 |
| Large semi-detached or end-of-terrace | 427 | 74 | 591 | 1,092 |
| Small semi-detached or end-of-terrace | 422 | 73 | 585 | 1,080 |
| Large mid-terrace | 244 | 22 | 118 | 384 |
| Small mid-terrace | 262 | 24 | 126 | 411 |
| Large top-floor flat | 137 | 9 | 97 | 243 |
| Small top-floor flat | 143 | 10 | 101 | 254 |
| Large other flat | 217 | 14 | 210 | 442 |
| Small other flat | 205 | 13 | 198 | 416 |
| **Total** | 2,608 | 321 | 2,850 | 5,779 |

**Table 22 Categorisation of different types of hard to treat**

| Easy to treat | Hard to treat unidentifiable | Hard to treat identifiable | Untreatable |
|---|---|---|---|
| 2.6m | Hard to treat – other (96,000)<br>Properties with cavity walls in areas of high exposure (225,000) | Standard cavities requiring remedial work (1.4m)<br>High rise – over 4 storeys (66,000)<br>Narrow cavities (535,000)<br>System build – concrete construction and metal frame (663,000)<br>Random stone (175,000) | 580,000 |

The estimated technical potential of hard-to-treat cavities is lower than in the consultation Impact Assessment, and the number of easy to treat cavities correspondingly higher. There are a number of reasons for this:

- It was previously assumed that 100% of non solid walled dwellings built between 1919 and 1939 had a narrow cavity. Inbuilt have reviewed this assumption through dialogue with industry stakeholders. They have reduced the total from 2.1 million to around 0.5 million.
- There is now more detailed information on wall types available on concrete frame construction. Previous data on concrete walls did not separate “no fines” construction (which should be classified as solid wall and not cavity wall). Concrete frame is now estimated as just over half a million when previously estimated as being over a million.
- The random stone estimate was previously based on estimations by local authorities. This has been revised using assumptions based on information from the British Geographic Survey which brought the estimated total down by approximately 230,000.
- The previous timber frame category has been refined and split into 4 separate categories all of which are now derived from the 2008 English Household Survey (EHS). They have been broken down into; metal construction (metal frame), timber frames with un-insulated studwork in dwellings with a masonry cavity, timber frames in buildings with no masonry cavity (this is not an empty cavity) and timber frames with insulated studwork in dwellings with a masonry cavity. The last category should have its masonry cavities left unfilled to maintain the integrity of the construction. This has created a new group of around 580,000 dwellings that have a cavity but are considered un-treatable.
- The original hardto-treat estimate did not include estimates of the number of standard empty cavities which are considered harder to fill due to: high rain and wind exposure, over

4 storeys high, or with faults in the outer wall which would need to be remediated before filling. These have now been grouped into a category entitled “standard cavities – some issues” in the Inbuilt report.

### *Solid Wall Insulation (SWI)*

The remaining potential for solid wall insulation is based on the number of solid wall properties within the housing stock, adjusted for the existing level of insulation and the amount expected to be insulated by January 2013 under existing policies. Within this potential there is wide range of types of solid wall each of which will lead to a different level of energy saving if insulated. The updated analysis presented in this Impact Assessment captures some of this variation.

The 2009 EHS solid wall categories and age band splits have been mapped to the different categories and age bands used in Standard Assessment Procedure (SAP). These have then be grouped into three broad categories based on the pre-insulation thermal performance of the wall. These are set out below.

**Table 23 Technical potential of SWI by house type (thousands)**

| | Type 1 | Type 2 | Type 3 | Total |
|---|---|---|---|---|
| Description of type | System build | Pre-1966 9” solid brick | Other solid walls | |
| Large detached house | 30 | 382 | 176 | 588 |
| Small detached house | 17 | 227 | 105 | 349 |
| Large semi-detached or end-of-terrace | 73 | 951 | 439 | 1463 |
| Small semi-detached or end-of-terrace | 40 | 527 | 243 | 810 |
| Large mid-terrace | 62 | 804 | 371 | 1237 |
| Small mid-terrace | 44 | 569 | 263 | 876 |
| Large top-floor flat | 21 | 265 | 122 | 408 |
| Small top-floor flat | 11 | 138 | 64 | 213 |
| Large other flat | 29 | 385 | 178 | 592 |
| Small other flat | 18 | 237 | 109 | 364 |
| **Total** | 345 | 4,485 | 2,070 | 6,900 |

### *Loft Insulation*

The research suggests that CERT has successfully driven cost-effective delivery of loft insulation and consequently there are diminishing numbers of un-insulated lofts remaining. A modelling assumption has been made that from 2013 onwards loft insulation will be focussed on topping up existing insulation (with a thickness of less than 150mm) to recommended standards rather than installing insulation where none existed previously. The energy savings from a loft insulation top-up are considerably lower than from insulating untreated lofts.

**Table 24 Technical potential of loft top-up by house type (thousands)**

| Description of type | Filled cavity | Unfilled cavity | Solid Wall | Total |
|---|---|---|---|---|
| Large detached house | 332 | 201 | 182 | 715 |
| Small detached house | 366 | 172 | 108 | 646 |

| | | | | |
|---|---|---|---|---|
| Large semi-detached or end-of-terrace | 537 | 394 | 453 | 1,385 |
| Small semi-detached or end-of-terrace | 544 | 337 | 251 | 1,132 |
| Large mid-terrace | 162 | 149 | 383 | 695 |
| Small mid-terrace | 177 | 151 | 271 | 600 |
| Large top-floor flat | 102 | 105 | 126 | 334 |
| Small top-floor flat | 80 | 96 | 66 | 242 |
| **Total** | 2,298 | 1,607 | 1,842 | 5,748 |

Table 25 shows how the estimates of LI potential are derived. The uptake of lofts in the model is driven more by the policy design than the stock of potential, so changes to these assumptions would have little effect on expected installations from Green Deal /ECO.

**Table 25: Decomposition of LI potential estimates (m)**

| | Source: | | |
|---|---|---|---|
| | Housing surveys (EHS, SHCS etc.) | DECC statistics including OfGEM, Warm Front etc. | DECC assumptions |
| Apr. '08 baseline | 13. 1 | | |
| Apr. '09 published data | | 12. 4 | |
| Dec. '11 published data | | 9.3 | |
| Assumed CERT/CESP etc. delivery in 2012 | | | 1.9 |
| Unfillable / hard to treat lofts | | | 1.7 |
| **Remaining potential at end Dec 2012** | | | **5.7** |

Assumptions:

1. Lofts with 125mm of insulation or more are treated as insulated and outside this potential.
2. Source of unfillable loft estimates is a BRE report from 2008, based on 2002-2004 EHCS data showing 6.8% of housing stock had lofts that were hard to treat/unfillable. See http://www.bre.co.uk/filelibrary/pdf/rpts/Hard_to_Treat_Homes_Part_I.pdf

### *High Efficiency (Condensing) Gas Boilers*

The number of condensing boilers in the housing stock has grown rapidly in recent years, as they are mandated by the Building Regulations for the replacement of domestic gas-fired and oil-fired boilers. DECC has estimated the remaining potential for the replacement of non-condensing gas boilers in 2013 by using data from the *Heating and Hot Water Industry Council* (HHIC). From 2005, when there were fewer than 2 million condensing boilers in the GB housing stock, there are projected to be approximately 11 million condensing boilers by 2013. This will leave about 12 million non-condensing gas boilers as the remaining technical potential for replacement. As 4% of GB homes have an oil-fired boiler, this means that the technical potential for improving the efficiency of oil-fired boilers is approximately 1 million.

### *Double Glazing*

The EHS[102] shows that 73% of English homes are fully double-glazed, 13% are at least half double-glazed, while 9% have no double glazing. This double glazing is predominantly PVC-U[103], which gives lower U-values than most metal or wooden frames. Building Regulations have generally required replacement glazing to be of at least E-rating since 2002, and C-rating since 2010.

The theoretical technical potential for double-glazing would be that all GB homes have A-rated double glazing. However, a feasible potential in the Green Deal period would be for households to take account of the need to replace windows due to house refurbishment, and to the need to replace double-glazed units as seals fail and the units mist up internally and their capacity for saving energy declines.

### *Floor Insulation*

There is little potential for floor insulation in cavity walled properties. For solid wall properties, it is estimated that there are 3,010,000 properties in England which could be suitable for floor insulation. This is estimated on the basis that there are 6,900,000 solid wall properties in England, of which 48.5% have suspended timber floors and it is assumed that 90% of these floors can be insulated.

Installing floor insulation is disruptive for most homes, requiring lifting of carpets and floorboards before installing insulation, replacing floorboards, and making good. This means that the willingness of households to go through this for a relatively small gain will be important, so, as with double-glazing, the theoretical technical potential is likely to be far greater than the feasible potential.

## Technical Potential in the Carbon Saving Communities Eligible Group

There is a degree of uncertainty in relation to the technical potential to deliver measures in the 15% of areas of Great Britain that are most deprived according to the Index of Multiple Deprivation (the CSC eligible group). This is due to small data sample issues when examining individual local areas in national housing surveys. The approach taken here has been to identify the regions the 15% most deprived areas are within, identify the amount of technical potential within each region, and assign a share of that potential to each deprived area based on the share of each region's population that

[102] http://www.communities.gov.uk/publications/corporate/statistics/ehs200910headlinereport
[103] English Housing Survey, housing stock report 2008
http://www.communities.gov.uk/documents/statistics/pdf/1750754.pdf

lives in that deprived area. The potential has been corrected for the estimated impact of previous energy efficiency schemes such as CERT. The estimated potential is detailed in the table below.

**Estimated technical potential in the Carbon Saving Communities Obligation eligible group**

| Measure | Potential (m) |
|---|---|
| 'Easy-to-treat' Cavity Wall Insulation | 0.36 |
| 'Hard-to-treat' Cavity Wall Insulation | 0.37 |
| Solid Wall Insulation | 1.00 |
| Loft Top-Up | 0.66 |

## Supply Chain Constraints

The Energy Company Obligation (ECO) is expected to drive a substantial increase in the uptake of SWI. Over the medium to long term, supply side constraints are unlikely to affect uptake. The nature of the insulation supply chain means that in the medium term the market will respond to higher demand and increase output. However, there may be constraints on the rate at which SWI can be delivered in the short term, primarily due to the rate at which qualified installers can be trained. Following discussion with industry on the rate at which the supply chain will be able to increase output, the supply chain constraints assumptions set out in Table 26 have been included in the analysis. These assumptions are based on training being delivered by an industry "fast track" approach. The uptake of SWI in the central scenario is lower than these supply constraints, suggesting they will not affect delivery.

**Table 26 Maximum annual take up of SWI due to supply constraints**

| Year | Range provided by industry | Assumption used |
|---|---|---|
| 2013 | 75,000 - 110,000 | 80,000 |
| 2014 | 105,000 - 155,000 | 150,000 |
| 2015 | 190,000 - 229,000 | 200,000 |

The current levels of delivery of cavity wall and loft insulation indicate that supply constraints will not affect the uptake of these measures under the Green Deal.

## Measure Costs

### *Installation Costs*

Cost assumptions for the main domestic sector energy-efficiency measures included in the analysis are based on the Supply Chain Review[104] (2009) and have been evaluated in DECC's *Review of costs and benefits of energy efficiency measures*[105]. This call for evidence asked stakeholders to submit evidence about the direct and additional costs of installation and the performance of energy efficiency measures. Around 300 responses were received and were analysed by Energy Efficiency Partnership for Homes (EEPH). The results of this analysis have been incorporated into the GDHM.

[104] *Solid Wall Insulation Supply Chain Review,* Purple Market Research, May 2009

[105] Undertaken by the Energy Efficiency Partnership for Homes (EEPH) and Purple Market Research (May 2011), responses were requested between 14 March and 4th April 2011.

For SWI, a simple linear relationship based on the EEPH call for evidence was used to determine the relationship between the size of property and likely installation costs. The costs are determined as follows:

Cost of internal SWI = £42.5 X external wall area ($m^2$) + £1900
Cost of external SWI = £57.7 X external wall area ($m^2$) + £5330

The cost of installing these measures in a typical 3 bedroom semi-detached house (with external wall area of 80$m^2$) is therefore £9,950 for external and £5,300 for internal SWI. Table 27 shows the cost assumptions used for internal and external SWI for different house types and Table 28 shows the cost assumptions for the other measures included in the analysis.

**Table 27 SWI installation costs assumptions by property size**

| House type | External wall area ($m^2$) | Internal SWI cost (£) | External SWI cost (£) |
|---|---|---|---|
| Large detached house | 147 | 8,147 | 13,800 |
| Small detached house | 86.03 | 5,556 | 10,300 |
| Large semi-detached or end-of-terrace | 91.9 | 5,806 | 10,650 |
| Small semi-detached or end-of-terrace | 65.61 | 4,688 | 9,100 |
| Large mid-terrace | 70.73 | 4,906 | 9,400 |
| Small mid-terrace | 45.6 | 3,838 | 7,950 |
| Large top-floor flat | 77.31 | 5,186 | 9,800 |
| Small top-floor flat | 47.97 | 3,939 | 8,100 |
| Large other flat | 61.41 | 4,510 | 8,850 |
| Small other flat | 45.42 | 3,830 | 7,950 |

**Table 28 Installation cost assumptions for domestic energy efficiency measures**

| Measure | Cost (£) |
|---|---|
| CWI – easy to treat | 500 |
| CWI – hard | 1,875 |
| Loft Insulation (professional) (150 to 250 mm) | 300 |
| Condensing gas boiler (G to A) | 2,500 |
| Floor insulation | 400 |
| Double glazing | 4,500 |
| Flue gas heat recovery | 400 |
| Draft proofing | 100 |

### *Additional/Hidden Costs*

Additional costs, sometimes known as hidden or hassle costs, are based on estimates of householder time spent researching, arranging, preparing for installation and returning their home to its previous condition. They also cover costs in addition to the installation cost that may be required when work is carried out independently of other major refurbishment or redecoration. Table 29 below sets out the assumptions that have been used. The assumptions about householder time and hassle costs are

based on Ecofys (2009), and assumptions about additional costs of installation have been drawn from EEPH (2011)[106][107]. These costs gradually rise as the value of household time rises.

**Table 29 Additional costs assumptions for domestic energy efficiency measures in 2013**

| | Additional costs to households (£) |
|---|---|
| Internal SWI | 4,937 |
| External SWI | 178 |
| CWI | 78 |
| Loft top up | 103 |
| Condensing gas boiler (G to A) | 97 |
| Floor insulation | 315 |
| Double glazing | 28 |
| Draft proofing | 19 |

## *Economies of Scale & Learning Rates*

### Economies of Scale

It is anticipated that economies of scale will reduce the per-house installation cost of external solid wall insulation in the social housing sector by treating entire blocks of flats / housing complexes in one go. This effect is incorporated by applying cost reduction factors to the per-house installation cost of external solid wall insulation in the social housing sector. Industry research has suggested that cost reductions of up to 30% can be delivered by treating multiple properties (this has been increased to 40% for flats to account for the greater economies of scale available). A sensitivity scenario is included in which action by local authorities and communities to co-ordinate delivery allows further economies of scale to be realised in the owner occupied and private rented sectors. These use a more conservative assumption of 20% cost reduction for measures delivered under the Carbon Saving Community target and a 10% cost reduction for measures delivered under the Carbon Saving Obligation.

### Learning Rates

Reductions in costs are expected to have been fully exploited in mature markets (eg. boilers and CWI). However, within the SWI industry there is considerable potential for reductions in installation costs. The external SWI market is currently dominated by labour intensive processes, but the use of pre-cut panels with a dry external finish could reduce the cost of labour and require less scaffolding, which acts as a major driver of onsite costs. Other innovations that could reduce costs include developing SWI systems that are easier to fit, thereby reducing labour costs, and new survey methods such as 3-D imaging using lasers. The cost of CWI fell by 50% between 1995 and 2005. Discussions with industry have suggested that SWI cost could fall by between 10% and 25% as output is increased. This Impact Assessment uses a central estimate of 15% with sensitivities of 10% and 20%.

[106] Ecofys (2009), "The hidden costs and benefits of domestic energy efficiency and carbon saving measures", http://www.decc.gov.uk%2Fassets%2Fdecc%2Fwhat%2520we%2520do%2Fsupporting%2520consumers%2Fsaving_energy%2Fanalysis%2F1_20100111103046_e_%40%40_ecofyshiddencostandbenefitsdefrafinaldec2009.pdf

[107] EEPH (2011) "Review of costs & benefits of energy efficiency measures", forthcoming.

## Energy Savings

The energy savings from insulation measures have previously been assessed using controlled field trials, typically with small samples. The establishment of the National Energy Efficiency Data-framework (NEED)[108] gives analysts access to individual households' energy use data. This has enabled provision of a wider and more robust understanding of energy use and energy efficiency. This dataset has been analysed for this assessment and has revealed that previous field trials overstate observed savings from energy efficiency measures.

DECC scientists have used NEED to provide estimates of underachievement in real-world energy savings from the measures relative to SAP predicted savings. These factors have been estimated through a comparison of NEED 'actuals' with SAP performance predictions for CWI. Relative to SAP predicted savings, performance estimates from NEED indicate that CWI only delivers 50% of these savings. It is assumed that three factors contribute towards this 50% reduction: physical underperformance or systematic difference between buildings physics models and in use savings achieved; a proportion of the building stock walls that are inaccessible; and a degree of comfort taking (also known as the rebound effect).

Based on a review of measured versus theoretical energy savings for CWI[109], a 35% 'In use' factor is applied to the original SAP estimate. In addition, it is estimated that approximately 10% of the building stock's external walls are inaccessible, reducing performance of CWI installations. Once these two factors are accounted for, the residual of approximately 15% additional underperformance is assumed to be due to comfort-taking.

At present similar data on SWI does not exist, but it is assumed that the inaccessibility and comfort factors above will be similar in magnitude and that an 'In use' factor should also be applied. DECC convened a task group of experts from industry and academia to review the available evidence and to make a recommendation on what in-use factors should be used at the launch of the Green Deal. The group recommended an in-use factor of 25% be applied to the savings from SWI. In addition, there is some evidence from field trials that the thermal performance of some solid walls before insulation is better than assumed in the SAP methodology. An additional 8% reduction in energy savings has been applied for SWI installed in this type of property to account for this. Research into the energy savings delivered by SWI is ongoing.

These adjustments to the energy savings estimate from SAP are outlined in the first table below for a representative property (a 3 bed semi detached house). The average energy saving before comfort taking for the different sized properties used in the analysis are outlined in the second table.

[108] NATIONAL ENERGY EFFICIENCY DATA-FRAMEWORK Report on the development of the data-framework and initial analysis. DECC, June 2011.

[109] Glasgow Caledonian University – *Review of differences between measured and theoretical energy savings for insulation measures* – (2006) http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving_energy/analysis/insulationmeasures-review.pdf

**Table 30 Energy savings from different measures for a 3 bed semi detached house**

| Measure | Savings SAP (kWh) | Inaccessibility factor | In use factor | Energy saving before comfort taking (kWh) | Bill saving before comfort taking (£)[110] | Comfort factor | Energy saving after comfort taking (kWh) |
|---|---|---|---|---|---|---|---|
| SWI: Type 1 | 9,111 | 10% | 25% | 6150 | £306 | 15% | 5,227 |
| SWI: Type 2 | 9,111 | | 25% + 8% | 5,494 | £274 | | 4,670 |
| SWI: Type 3 | 5,614 | | 25% | 3,789 | £190 | | 3,221 |
| CWI | 4,569 | | 35% | 2,673 | £134 | | 2,272 |
| Loft top up | 845[111] | 41% | | 499 | £25 | | 424 |

**Table 31 Energy savings before comfort taking from the main insulation measures for different property sizes and wall types (kWh)**

| | Large detached house | Small detached house | Large semi-detached | Small semi-detached | Large mid-terrace | Small mid-terrace | Large top-floor flat | Small top-floor flat | Large other flat | Small other flat |
|---|---|---|---|---|---|---|---|---|---|---|
| Solid wall type 1 | | | | | | | | | | |
| SWI internal | 12,078 | 6,119 | 7,315 | 5,001 | 5,204 | 3,134 | 5,736 | 3,594 | 4,300 | 2,934 |
| SWI external | 12,032 | 6,094 | 7,291 | 4,983 | 5,187 | 3,121 | 5,716 | 3,570 | 4,286 | 2,925 |
| Solid wall type 2 | | | | | | | | | | |
| SWI internal | 10,752 | 5,448 | 6,512 | 4,452 | 4,633 | 2,790 | 5,107 | 3,200 | 3,828 | 2,612 |
| SWI external | 10,712 | 5,425 | 6,491 | 4,436 | 4,618 | 2,778 | 5,089 | 3,178 | 3,815 | 2,604 |
| Solid wall type 3 | | | | | | | | | | |
| SWI internal | 7,438 | 3,769 | 4,505 | 3,080 | 3,205 | 1,930 | 3,533 | 2,214 | 2,648 | 1,807 |
| SWI external | 7,410 | 3,753 | 4,490 | 3,069 | 3,195 | 1,922 | 3,520 | 2,199 | 2,639 | 1,801 |
| Loft and cavity insulation | | | | | | | | | | |
| CWI | 4,260 | 2,468 | 3,290 | 2,115 | 2,605 | 1,538 | 2,272 | 1,855 | 1,858 | 1,131 |
| Loft top up | 1,122 | 850 | 680 | 533 | 590 | 456 | 853 | 463 | - | - |

### *Adjustment for Under-Heating*

There is evidence that low income and vulnerable households under-heat their houses by approximately one degree compared with households in the non-priority group (in addition to any under heating relative to SAP assumptions)[112]. To reflect the fact that under-heating by these households means they will not achieve the same savings, the energy savings for priority group households are reduced by 10% when calculating net bill savings. This reduction impacts on the Utility function (see Annex B) affecting customer preference and therefore the probability of uptake.

[110] In 2013 for a household with gas central heating (5.0 p/kWh)

[111] An illustrative top up from 100mm of loft insulation to 250mm is used

[112] This is to reflect the fact that under-heating by low income and vulnerable households means they will not achieve the same savings. The 2008 Warm Front evaluation (Green and Gilbertson, 2008) shows that before receiving heating and insulation measures, Warm Front eligible households (an imperfect but solid proxy for Affordable Warmth eligible households) typically heated their living rooms across a relatively low distribution of temperatures, averaging 17.9°C.

## Green Deal Mechanism Assumptions

### *Assessment costs*

A total assessment cost of £112.50 has been estimated based on the following assumptions: It is estimated that the cost of the fabric component of domestic assessments will be £75, the same as for an Energy Performance Certificate (EPC). Occupancy assessments are assumed to require between one and two hours, costed at £25/hour, with a central estimate of £37.50.[2]

We expect there to be a range of business models in the market. Some may require customers to pay some of the assessment costs upfront , while others may provide free assessments and pass on the cost of unsuccessful assessment to their Green Deal customers. In other cases unsuccessful assessment cost will be lower than assumed (e.g. in delivery by social housing associations). Our central estimate of demand for the Green Deal uses the assumption that 1 in 3 assessments will result in a Green Deal, and that of the 2 unsuccessful assessments the cost of 1 will be recovered from the each Green Deal. The cost of the other is assumed to be covered by the following:

- consumers will pay a small amount upfront for assessments in some cases;
- unsuccessful assessments will not cost as much as successful assessments in some cases (due to the assessor determining that the customers is not eligible or interested before the full assessment has been done);
- the unsuccessful assessment cost will be lower in the social housing sector; and
- a certain level of fixed cost for survey's are already included in the EEPH installation costs measure

### *Green Deal provider costs*

The Green Deal provider incurs costs in coordinating and administering the advice and sales process. The model splits these costs into one-off and recurring costs. It is assumed that once a householder has decided in favour of taking up a Green Deal after the assessment has been concluded, then the provider will spend one hour in advising and arranging the administrative details of a particular plan. The model assumes the hourly cost of labour at the rate equivalent to that of a financial adviser at £16. The hourly rate is based on the government's Standard Cost Methodology used to estimate cost of working time.

The Green Deal provider also incurs costs in respect of overheads and of compliance with mandated responsibilities. Whereas the Standard Cost Methodology usually costs overheads at 30% of a one-off labour cost, the model assumes a more conservative rate of 50% to reflect a range of mandated responsibilities. These costs are subsumed within the recurring overhead rate of £8 per Green Deal plan. The full range of mandated responsibilities is itemised in the Chapter 8 "Green Deal Mechanism Costs" of the Impact Assessment.

**Table 32 Green Deal Mechanism Costs used in the modelling**

| | Cost |
|---|---|
| The Green Deal set up costs (£) | 16 |
| The ongoing Green Deal management costs (£ pa) | 8 |

[2] Rate for the equivalent skill set of a Quantity Surveyor, based on the Standard Cost Model.

### *Green Deal Interest Rates*

This Impact Assessment makes the following assumptions for Green Deal interest rates in the domestic sector. Further analysis on this can be found in Annex I.

**Table 33 Green Deal Interest rates used in the modelling**

| | |
|---|---|
| Low | 6.50% |
| Central | 7.50% |
| High | 9.50% |

## Green Deal Repayment terms

The central run presumes that the  Green Deal repayment is allowed to rise 2% per year throughout the repayment period . Further analysis of the effect of this can be found in Annex G.

### *Green Deal Repayment periods*

The choice of repayment period is important because it affects the annual Green Deal charge and hence the net bill savings consumers receive. For example, a £1000 measure would require an annual Green Deal charge of £146 if paid back in flat instalments over ten years, assuming a 7.5% interest rate. But if paid back over twenty years, the charge would be just £98 pounds. So if the measure is expected to save £150 annually, the customer could expect bill savings of £4 a year if paying back over ten years and £52 if paying back over twenty. This trade-off between higher bill saving (good) and longer repayment period (bad) is reflected in the consumer preference section of the model where uptake is affected positively by the first component and negatively by the second.

As such, we have selected standard repayment periods for each measure to best reflect their cost and performance, so as to achieve a certain level of net bill savings while keeping repayment periods to a reasonable length. Hence all solid wall insulation packages are repaid over twenty years and all cavity wall insulation packages are paid back over ten years. In reality, customers will be free to choose their own preferred repayment period, within Golden Rule constraints, so in this respect the modelling is conservative.

**Table 34 Repayment term assumptions used in the modelling**

| Measure | Repayment term |
|---|---|
| SWI (internal and external) | 20 years |
| CWI, Loft top-up | 10 years |

## Energy Price Assumptions

**Table 35 Energy price assumptions - variable price element**

| Domestic Sector | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity | p/KWh (2011) | High | 8.4 | 9.4 | 10.0 | 9.8 | 9.6 | 9.6 | 10.0 | 10.1 | 10.5 | 10.7 | 11.0 | 11.2 | 11.4 | 11.9 | 12.2 |
| | | Central | 8.4 | 8.8 | 9.3 | 9.2 | 9.2 | 9.2 | 9.3 | 9.0 | 9.0 | 9.3 | 9.7 | 9.9 | 10.0 | 10.6 | 10.9 |
| | | Low | 7.7 | 6.7 | 6.5 | 6.7 | 6.6 | 6.3 | 6.5 | 6.4 | 6.7 | 7.2 | 7.6 | 7.9 | 7.7 | 8.4 | 8.8 |
| Gas | p/KWh (2011) | High | 2.3 | 2.8 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.6 | 3.6 | 3.6 |
| | | Central | 2.3 | 2.5 | 2.7 | 2.9 | 2.9 | 2.9 | 2.8 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| | | Low | 2.3 | 1.8 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 |
| Burning Oil | p/litre (2011) | High | 53.7 | 54.6 | 55.9 | 57.3 | 58.4 | 59.5 | 60.7 | 61.9 | 63.2 | 64.4 | 65.7 | 67.0 | 68.4 | 69.8 | 71.2 |
| | | Central | 53.7 | 54.0 | 54.6 | 55.2 | 55.6 | 56.1 | 56.5 | 56.9 | 57.3 | 57.8 | 58.2 | 58.6 | 59.1 | 59.5 | 60.0 |
| | | Low | 53.7 | 52.6 | 52.0 | 51.4 | 50.5 | 49.7 | 48.9 | 48.1 | 47.3 | 46.5 | 45.7 | 45.0 | 44.3 | 43.6 | 42.9 |

| Non-domestic sector | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity | p/KWh (2011) | High | 8.4 | 9.4 | 10.0 | 9.8 | 9.6 | 9.6 | 10.0 | 10.1 | 10.5 | 10.7 | 11.0 | 11.2 | 11.4 | 11.9 | 12.2 |
| | | Central | 8.4 | 8.8 | 9.3 | 9.2 | 9.2 | 9.2 | 9.3 | 9.0 | 9.0 | 9.3 | 9.7 | 9.9 | 10.0 | 10.6 | 10.9 |
| | | Low | 7.7 | 6.7 | 6.5 | 6.7 | 6.6 | 6.3 | 6.5 | 6.4 | 6.7 | 7.2 | 7.6 | 7.9 | 7.7 | 8.4 | 8.8 |
| | p/KWh | High | 2.3 | 2.8 | 2.9 | 3.0 | 3.1 | 3.1 | 3.2 | 3.3 | 3.4 | 3.4 | 3.5 | 3.6 | 3.6 | 3.6 | 3.6 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gas | (2011) | Central | 2.3 | 2.5 | 2.7 | 2.9 | 2.9 | 2.9 | 2.8 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| | | Low | 2.3 | 1.8 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 |

**Table 36 Energy price assumptions - retail prices**

| Domestic Sector | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity | p/KWh (2011) | High | 14.8 | 16.5 | 17.3 | 17.8 | 17.8 | 18.3 | 19.1 | 19.1 | 20.1 | 20.7 | 21.2 | 21.5 | 21.5 | 22.0 | 22.5 |
| | | Central | 14.8 | 15.9 | 16.7 | 17.2 | 17.4 | 18.0 | 18.3 | 18.0 | 18.6 | 19.3 | 19.9 | 20.2 | 20.2 | 20.7 | 21.2 |
| | | Low | 14.1 | 13.5 | 13.2 | 13.9 | 13.8 | 13.9 | 14.4 | 14.1 | 14.8 | 15.5 | 15.9 | 16.5 | 16.2 | 17.0 | 17.5 |
| Gas | p/KWh (2011) | High | 4.4 | 5.2 | 5.3 | 5.5 | 5.7 | 5.9 | 6.0 | 6.1 | 6.2 | 6.4 | 6.5 | 6.6 | 6.7 | 6.7 | 6.7 |
| | | Central | 4.4 | 4.8 | 5.0 | 5.4 | 5.5 | 5.6 | 5.4 | 5.1 | 5.2 | 5.2 | 5.3 | 5.3 | 5.3 | 5.3 | 5.3 |
| | | Low | 4.4 | 3.8 | 3.0 | 3.2 | 3.3 | 3.4 | 3.5 | 3.5 | 3.6 | 3.7 | 3.7 | 3.8 | 3.9 | 3.9 | 4.0 |
| Burning Oil | p/litre (2011) | High | 62.7 | 63.9 | 65.1 | 66.4 | 67.7 | 69.1 | 70.4 | 71.8 | 73.3 | 74.7 | 76.2 | 77.8 | 79.3 | 80.9 | 82.6 |
| | | Central | 62.7 | 63.1 | 63.6 | 64.1 | 64.6 | 65.0 | 65.5 | 66.0 | 66.5 | 67.0 | 67.5 | 68.0 | 68.5 | 69.0 | 69.6 |
| | | Low | 62.7 | 61.6 | 60.6 | 59.6 | 58.6 | 57.6 | 56.7 | 55.7 | 54.8 | 53.9 | 53.1 | 52.2 | 51.3 | 50.5 | 49.7 |

| Non-domestic sector | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity | p/KWh | High | 12.5 | 13.7 | 14.6 | 14.7 | 14.4 | 14.6 | 15.2 | 15.4 | 16.1 | 16.6 | 17.1 | 17.3 | 17.4 | 18.0 | 18.3 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (2011) | Central | 12.4 | 13.1 | 14.0 | 14.1 | 14.1 | 14.3 | 14.5 | 14.4 | 14.7 | 15.2 | 15.8 | 16.1 | 16.2 | 16.7 | 17.1 |
| | | Low | 11.8 | 11.1 | 11.1 | 11.4 | 11.1 | 11.0 | 11.2 | 11.1 | 11.5 | 12.1 | 12.3 | 12.7 | 12.5 | 13.3 | 13.7 |
| Gas | p/KWh (2011) | High | 3.3 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 5.0 | 5.0 | 5.0 | 5.0 |
| | | Central | 3.3 | 3.5 | 3.7 | 4.0 | 4.1 | 4.1 | 3.9 | 3.7 | 3.7 | 3.8 | 3.8 | 3.8 | 3.8 | 3.9 | 3.9 |
| | | Low | 3.3 | 2.7 | 2.1 | 2.2 | 2.2 | 2.2 | 2.3 | 2.3 | 2.4 | 2.5 | 2.5 | 2.6 | 2.6 | 2.7 | 2.8 |

## Energy Emissions Assumptions

**Table 37 Energy emissions assumptions - variable and retail elements**

| Domestic Sector | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $kgCO_2/kWh$ | Gas | | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| | Oil | | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| | | | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| | Electricity | Marginal | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 | 0.37 |
| | | Retail | 0.45 | 0.46 | 0.44 | 0.44 | 0.41 | 0.36 | 0.35 | 0.30 | 0.29 | 0.30 | 0.28 | 0.26 | 0.25 | 0.24 | 0.23 |

## Air Quality Damage Cost Assumptions

**Table 38 Air Quality damage assumptions**

| Domestic | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (p/KWh) | Gas | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 |
| | Oil | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 | 0.74 | 0.85 | 0.85 | 0.85 | 0.85 | 0.87 | 0.88 | 0.90 | 0.92 | 0.94 |
| | Solid | 4.98 | 5.09 | 5.20 | 5.30 | 5.41 | 5.51 | 5.62 | 5.73 | 5.83 | 5.94 | 6.06 | 6.18 | 6.30 | 6.43 | 6.56 |
| | Electricity | 0.13 | 0.13 | 0.13 | 0.13 | 0.14 | 0.14 | 0.14 | 0.15 | 0.15 | 0.15 | 0.15 | 0.16 | 0.16 | 0.16 | 0.17 |

## Carbon prices

Valuations of the savings pertaining to avoided carbon emissions are made according to projected EU Emissions Trading Scheme Allowance (EUA) prices, and modelled shadow prices of carbon. These are in line with Interdepartmental Analysts' Group accepted projections[113].

**Table 39 EUA price assumptions and shadow price of carbon assumptions**

| | | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Traded carbon value | £/tCO2 (2011) | High | 17.4 | 18.5 | 20.0 | 21.3 | 23.5 | 26.5 | 27.8 | 30.8 | 32.7 | 35.5 | 43.1 | 50.6 | 58.2 | 65.8 | 73.4 |
| | | Central | 13.5 | 14.5 | 15.9 | 17.1 | 18.9 | 20.5 | 21.9 | 23.5 | 25.7 | 28.5 | 33.1 | 37.7 | 42.2 | 46.8 | 51.4 |
| | | Low | 6.4 | 7.2 | 8.8 | 10.0 | 11.5 | 13.8 | 15.1 | 15.9 | 17.2 | 19.1 | 20.9 | 22.7 | 24.5 | 26.3 | 28.1 |
| Non-traded carbon value | £/tCO2 (2011) | High | 83.5 | 84.7 | 86.0 | 87.3 | 88.6 | 89.9 | 91.3 | 92.6 | 94.0 | 95.4 | 97.0 | 98.6 | 100.2 | 101.8 | 103.4 |
| | | Central | 55.6 | 56.5 | 57.3 | 58.2 | 59.1 | 59.9 | 60.8 | 61.7 | 62.7 | 63.6 | 64.7 | 65.7 | 66.8 | 67.9 | 68.9 |
| | | Low | 27.8 | 28.2 | 28.7 | 29.1 | 29.5 | 30.0 | 30.4 | 30.9 | 31.3 | 31.8 | 32.3 | 32.9 | 33.4 | 33.9 | 34.5 |

# Non-Domestic Sector Model Inputs

## Measures

Details on measures are taken from the Non-Domestic Buildings Energy and Emissions Model (N-DEEM), produced by BRE, including costs, abatement potentials and lifetimes. Assumed take-up rates are taken from Element Energy's analysis[114] and are adjusted according to projected policy savings[115] as described in the main body of this document. Assumptions relating to these measures are presented in the table below.

[113] Available at http://www.decc.gov.uk/en/content/cms/about/ec_social_res/iag_guidance/iag_guidance.aspx
[114] *Uptake of energy efficiency in buildings*. Element Energy (2009) http://downloads.theccc.org.uk/docs/Element%20Energy_final_efficiency_buildings.pdf
[115] DECC Energy Model projections

Table 40 Eligible Green Deal measures in the non-domestic sector

| | | | Energy savings potential in 2010 (GWh pa) | | | | | |
|---|---|---|---|---|---|---|---|---|
| Measure | Lifetime of measure (Years) | Total capital costs (2010) | Electricity | Gas | Coal | Oil | Total | BAU take-up to 2020 (% of 2010 potential) |
| Programmable Thermostats | 10 | 44 | 2,728 | 15,318 | 0 | 2,005 | 20,051 | 46% |
| Basic Lighting Timer | 10 | 6 | 6,187 | 0 | 0 | 0 | 6,187 | 32% |
| Light Detectors | 10 | 10 | 652 | 0 | 0 | 0 | 652 | 32% |
| Sunrise-Sunset Lighting Timers | 10 | 0 | 657 | 0 | 0 | 0 | 657 | 32% |
| Presence detector | 10 | 478 | 1,802 | 0 | 0 | 0 | 1,802 | 33% |
| Stairwell timer | 10 | 46 | 1,144 | 0 | 0 | 0 | 1,144 | 29% |
| Compressed Air - Reduced Inlet Temp | 5 | 1 | 16 | 0 | 0 | 0 | 16 | 76% |
| Heating - More efficient air conditioning | 10 | 0 | 1,975 | 40 | 0 | 0 | 2,015 | 99% |
| 4 Pole Motor - EFF1 replace 4 Pole | 3 | 1 | 10 | 0 | 0 | 0 | 10 | 67% |
| Variable Speed Drives medium | 3 | 0 | 3 | 0 | 0 | 0 | 3 | 66% |
| Variable Speed Drives small | 3 | 1 | 8 | 0 | 0 | 0 | 8 | 66% |
| Windows - Double Glazing  Air Filled | 20 | 21 | 8 | 24 | 0 | 3 | 36 | 69% |

| | | | Energy savings potential in 2010 (GWh pa) | | | | | |
|---|---|---|---|---|---|---|---|---|
| Measure | Lifetime of measure (Years) | Total capital costs (2010) | Electricity | Gas | Coal | Oil | Total | BAU take-up to 2020 (% of 2010 potential) |
| Windows - Double Glazing Argon Filled | 20 | 17 | 5 | 19 | 0 | 3 | 27 | 69% |
| Windows - Low E Double Glazing - Air Filled | 20 | 25 | 9 | 27 | 0 | 4 | 40 | 69% |
| Windows - Low E Double Glazing - Argon Filled | 20 | 23 | 7 | 26 | 0 | 4 | 36 | 69% |
| Windows - Ultra-Low E Double Glazing - Air Filled | 20 | 27 | 10 | 29 | 0 | 4 | 43 | 69% |
| Windows - Ultra-Low E Double Glazing - Argon Filled | 20 | 20 | 7 | 22 | 0 | 3 | 32 | 69% |
| Insulation - Roof - Flat 100 mm | 20 | 582 | 270 | 1,463 | 0 | 193 | 1,925 | 19% |
| Insulation - Roof - Flat 150 mm | 20 | 671 | 272 | 1,186 | 0 | 162 | 1,620 | 19% |
| Insulation - Roof - Flat 200 mm | 20 | 283 | 240 | 422 | 0 | 74 | 736 | 19% |
| Insulation - Roof - Flat 80mm | 20 | 566 | 266 | 1,445 | 0 | 190 | 1,902 | 19% |
| Insulation - Roof - Pitched 100mm | 20 | 570 | 480 | 992 | 0 | 164 | 1,635 | 20% |
| Insulation - Roof - Pitched 150mm | 20 | 157 | 327 | 84 | 0 | 46 | 457 | 20% |
| Insulation - Roof - Pitched 200mm | 20 | 198 | 320 | 86 | 0 | 45 | 451 | 20% |
| Insulation - Roof - Pitched 80mm | 20 | 549 | 473 | 968 | 0 | 160 | 1,602 | 20% |

| | | | Energy savings potential in 2010 (GWh pa) | | | | | |
|---|---|---|---|---|---|---|---|---|
| Measure | Lifetime of measure (Years) | Total capital costs (2010) | Electricity | Gas | Coal | Oil | Total | BAU take-up to 2020 (% of 2010 potential) |
| Insulation -Wall - External Cladding 50mm | 20 | 19 | 6 | 20 | 0 | 3 | 29 | 37% |
| Insulation -Wall - Masonary Cavity 100mm | 20 | 76 | 179 | 60 | 0 | 27 | 265 | 30% |
| Insulation -Wall - Masonary Cavity 65mm | 20 | 108 | 217 | 137 | 0 | 35 | 389 | 30% |
| Insulation -Wall - Masonary Cavity 75mm | 20 | 54 | 176 | 59 | 0 | 26 | 262 | 30% |
| Lights - 16 mm Fluorescent Tubes Replace 26mm | 3 | 95 | 643 | 0 | 0 | 0 | 643 | 53% |
| Lights - Compact Fluorescent Lamps without ECG & Tungsten | 3 | 110 | 2,521 | 0 | 0 | 0 | 2,521 | 72% |
| Lights - ECG Compact Fluorescent Lamps & Tungsten | 3 | 282 | 2,558 | 0 | 0 | 0 | 2,558 | 72% |
| Lights - HF Ballast | 3 | 94 | 664 | 0 | 0 | 0 | 664 | 70% |
| Lights - IRC Tungsten-Halogen - Spots | 3 | 25 | 344 | 0 | 0 | 0 | 344 | 74% |
| Lights - LEDs Replace 26mm Fluorescent Tubes | 3 | 118 | 887 | 0 | 0 | 0 | 887 | 53% |
| Lights - Metal Halide Floods | 3 | 7 | 90 | 0 | 0 | 0 | 90 | 68% |
| Heating - TRVs Fully Installed | 10 | 22 | 0 | 5,713 | 0 | 3,858 | 9,571 | 54% |

## Non-Domestic Sector Costs

The assumed assessment costs are given by qualitative size of building. The costs assumed in this assessment are listed in the table below.

**Table 41 Non-domestic buildings' assessment costs**

| Small | Medium | Large |
|---|---|---|
| £250 | £500 | £1,000 |

There are assumed to be other costs above the assessment costs, in particular hidden costs. Hidden costs are taken as equivalent to a 20% mark-up on capital. This is based on findings from a literature review[116], and takes the mean of the estimates for generic transaction costs.

The buildings that fall under each of these categories is illustrated in the table below, taken from Carbon Trust/AEA work on Green Deal scenarios of hypothetical non-domestic buildings.

[116] *Review and development of carbon dioxide abatement curves for available technologies as part of the Energy Efficiency Innovation Review* (Enviros, 2006) http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving_energy/analysis/enviros-report.pdf (p43)

Table 42 Non-domestic buildings illustrative categorisation

| Size category | Illustrative buildings |
|---|---|
| **Small (37%)** | Small office<br>Surgery (small building)<br>Hotels and catering - Pub<br>Hotels and catering - B&B<br>small food shop<br>small industrial unit (light manufacturing) |
| **Medium (29%)** | Medium office, single occupancy<br>Medium office, multiple occupancy 1 floor on large building.<br>School in one medium sized building<br>Medium multiple building school<br>Hotels and catering - Hotel in listed building<br>Medium size store in outlet centre<br>Medium department store<br>Medium sized leisure centre with swimming pool<br>Heated warehouse - medium size. No cooling<br>Medium industrial unit |
| **Large (19%)** | Large office including data centre<br>Hospital (large building)<br>Air conditioned prestige hotel<br>Large supermarket |
| **Unknown (15%)** | Other<br>Communication and transport<br>Government<br>Agriculture |

## Affordable Warmth Model Assumptions

Input assumptions for the Affordable Warmth model are consistent with those for the Green Deal Household Model in relation to insulation measures, energy prices, carbon values and air quality damage factors. The primary differences relate to the treatment of heating measures, the approach to which is summarised in section 0. The estimated maximum technical potential for installing major measures that would score against the Affordable Warmth target

in the eligible group is shown in Table 43. The potential is adjusted for the anticipated installation of measures to Affordable Warmth eligible households under schemes such as CERT and Warm Front leading up to the launch of Green Deal and ECO. It is important to note that in modelling uptake of measures in the Affordable Warmth eligible group those measures installed under the Green Deal are removed from this technical potential first (reflecting the likelihood that measures are unlikely to be subsidised if households are willing to take out Green Deal packages unassisted), and a further downward adjustment is made to reflect uncertainty around likelihood of household take up. See Annex D for more details.

**Table 43 Technical potential for Affordable Warmth eligible measures in 2013**

| Measure | Technical Potential in 2013 (million) |
|---|---|
| Cavity Wall Insulation (Easy To Treat) | 0.24 |
| Cavity Wall Insulation (Hard To Treat) | 0.13 |
| Loft Top Up Insulation (150mm to 250mm) | 1.00 |
| Solid Wall Insulation | 0.83 |
| Install New Central Heating (where none previously existed) | 0.13 |
| Replace Broken Boilers* | 0.16 **per year** |

* Boiler replacement opportunities are a flow, whereby more opportunities become available each year[117]

## Heating Counterfactual and Under-heating

The below table sets out the assumptions underpinning the counterfactual for the installation of heating systems under the Affordable Warmth target.

[117] Source: EHS, SHCS, LIWS (adjusted for CERT and Warm Front installations up to Green Deal and ECO launch)

Table 44 Assumptions underpinning changes in energy use resulting from installation of Affordable Warmth Heating Measures

| Heating Measure | Before Installation of AW Heating Measures | After Installation of AW Heating Measures |
|---|---|---|
| **New Electric Central Heating** | Non-central, non-storage electric heating | Electric central storage heaters |
| **New Gas Central Heating** | Non-central, non-storage electric heating for 60% of households and 40% of households with gas non-central heating or gas room heating[118]. | Full gas central heating system |
| **New Oil Central Heating** | Non-central, non-storage electric heating for 60% of households and 40% of households with oil non-central heating or gas room heating. | Full oil central heating system |
| **Oil Replacement Boiler** | Non-central, non-storage electric heating for 60% of households and oil non central heating for 40%. | Boiler is replaced by A/B – rated boiler in base year |
| **Gas Replacement Boiler** | Non-central, non-storage electric heating for 60% of households and 40% of households with gas non-central heating or gas room heating or intermittent use of a gas boiler. | Boiler is replaced by A/B – rated boiler in base year |
| **LPG Replacement Boiler** | Non-central, non-storage electric heating. | Boiler is replaced by A/B – rated boiler in base year |

The other primary difference is that for households eligible for Affordable Warmth measures, a level of under-heating is assumed – it is assumed that all households heat to 18°C before an installation and 19°C after an installation.[119] The energy changes relating to the repair or installation of a new heating system will be dependent on other characteristics of the dwelling, in particular the level of insulation present. The level of insulation is assumed to be the average for cavity wall homes (around 70%) and no insulation for solid wall homes (around 30%) prior to heating repairs. After heating measures are installed it is assumed that if a household's cavity wall was not filled pre-intervention, it would be filled at the same time as the heating system is installed.

[118] This is based on data from previous Government schemes which shows that when a heating system was not fully functional pre-installation, around 60% of households used non-central electric heating, and around 40% used non-central gas heating/an intermittent gas boiler.
[119] Based on evidence from the Warm Front Study Group Evaluation for the average internal temperature pre and post intervention; Available at: http://www.apho.org.uk/resource/item.aspx?RID=53281

# Annex B: The Green Deal Household Model

## Overview

The impact on the domestic sector of the Green Deal and the Energy Company Obligation (ECO) Carbon targets has been modelled using the Green Deal Household Model (GDHM). This model simulates the uptake of energy efficiency measures amongst British households based on the characteristics of households, insulation measures and other economic factors. Different sensitivity scenarios have been modelled to represent different possible trajectories for Green Deal take-up.

This annex describes how the GDHM works. The first section discusses the technical inputs to the GDHM. This includes the characterisation of the housing stock and a discussion of the remaining opportunities for major building fabric energy efficiency improvements. The second section describes how the model estimates uptake of those opportunities. This includes a description of the model of consumer choices and the parameters underlying the demand scenarios that have been used to illustrate the range of potential impacts of the Green Deal and ECO. The third section describes the approach taken to modelling the behaviour of energy companies as they subsidise energy efficiency measures in order to meet the carbon target at least cost. Further details of the classification of the housing stock, the SAP calculations used to estimate energy saving and the analysis of the Green Deal consumer survey responses can be found in the Green Deal Household Model Assumptions Document published alongside the Consultation Impact Assessment.[120]

## Homes and measures

### Classification of the Housing Stock

In order to represent the varied nature of the housing stock's current physical and energy efficiency characteristics, the GDHM uses data from the English House Condition Survey 2007/08, the Scottish House Condition Survey 2007/09, and the Living in Wales Survey to segment the housing stock into the following groups:

- 5 dwelling types split by large and small size;
- 5 fuel and 16 heating system types;
- 3 high-level external wall types (filled cavity walls, unfilled cavity, solid walls); within which…
    - 3 types of unfilled cavity walls(easy to treat, identifiable hard to treat, unidentifiable hard to treat)
    - 3 bands of solid wall performance potential;
- 3 levels of loft insulation
- 3 tenures (social housing, private rented and owner occupied); and
- 2 socio-economic groups (based on the eligibility criteria for Affordable Warmth support)

This segmentation results in 3,866 house types for Great Britain.
For the purposes of identifying the low income and vulnerable groups (based on the CERT super priority group), survey responses regarding the receipt of benefits are used. Survey responses have

[120] http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx

been found to understate the number of benefit claimants found in administrative sources[121]. To account for this the survey-derived housing stock lived in by low income and vulnerable groups has been scaled up to match the estimate derived from administrative data[122].

### Major Building Fabric Measures

Three major insulation measures are considered:

- Solid Wall Insulation (SWI) (applying insulation to the exterior or interior of a wall without cavity);
- Cavity Wall Insulation (CWI) (applying insulation to a wall cavity, or in some extreme hard to treat cases, the exterior or interior of the wall); and
- Loft-top-up Insulation (LI) (increasing the depth of loft insulation to 270mm).

The remaining technical potential of these measure in 2013 is described in Annex A, along with their associated costs. The housing survey results have been adjusted to reflect this estimate of potential. The impacts of measures on a home's modelled energy consumption are estimated using the Standard Assessment Procedure (SAP 2005) for energy rating of dwellings[123]. This is based upon the average house characteristics for each segment of the model with some values imputed from other characteristics. Adjustments have been made to the original SAP calculation of energy saving delivered by different measures as set out in Annex A. This adjustment rescales the average savings from measures installed in semi detached houses in the model to match the savings in a typical 3 bed semi detached house. The estimated impacts of measures in the other house-types have been scaled using the same percentage[124].

## Modelling Uptake

This section first outlines the sequence of steps that are modelled each year to determine the uptake of energy efficiency measures. It highlights several key parameters that are used to estimate the demand for measures under the Green Deal.

### Decision Sequence

The GDHM estimates consumer uptake of the Green Deal by simulating consumer decisions for each segment of the housing stock in each year of the simulation period (2013-2022). This is based on the following six steps:

a) A fraction of each housing stock segment is assumed to make a decision whether to take up a Green Deal - the "*decision making frequency*" or *"trigger point frequency"*.
b) The expected year 1 total bill savings are calculated for each eligible package of measures using the technical energy saving delivered and the relevant fuel price.

[121] See annex 3 in : http://www.decc.gov.uk/assets/decc/Consultations/warm-front-eligibility/1442-ia-warm-front-eligibility.pdf
[122] The stock of homes lived in by other households has been correspondingly scaled down.
[123] http://projects.bre.co.uk/sap2005/
[124] Analysis of the relationship between the difference between theoretical performance and that observed in recent analysis of data from the National Energy Efficiency Data-framework, showed no consistent relationship between "underperformance" and dwelling size. DECC(2011) "Development of NEED and initial analysis" http://www.decc.gov.uk/media/viewfile.ashx?filetype=4&filepath=11/stats/energy/energy-efficiency/2078-need-data-framework-report.pdf

c) The Green Deal charge is calculated, based on the assumed interest rate, the length of the repayment period and the installation cost of the measure (after deducting the assumed ECO subsidy).
d) For each option that meets the Golden Rule[125], a consumer "utility" score that reflects the desirability of each option is calculated. The utility score reflects the value consumer place on future energy price rises, but the Golden Rule calculation does not.
e) The utility score weights the characteristics of the package offered to the consumer. These weights are based on consumer *choice coefficients* that have been estimated by fitting a logit model to the Green Deal consumer survey responses. The characteristics that are included are:
    i. The measure itself – reflecting consumers' bias for or against any particular measures
    ii. The expected net bill saving (after deducting the Green Deal charge)
    iii. The repayment period
    iv. The cost of the assessment
    v. The upfront cost (zero for Green Deal measures)

f) The take-up of each option is based upon the relative utility of each available option, including a 'do nothing' option. The utility is derived by combining the coefficients and the characteristics for a given option.

## Demand Parameters and Their Influences

The key consumer demand parameters are: the decision making frequency, the consumer choice coefficients, and the characteristics of the offer to consumers (in particular the expected future bill savings[126]). Each of these is discussed in turn, highlighting the evidence and assumptions that have been used to arrive at parameter values.

### *Customer Decision Making Frequency*

The decision making frequency represents the rate at which households are presented with the same choices presented to the respondents to the Green Deal consumer survey. There are a range of triggers that could lead to a household considering whether to take up a Green Deal. Initial estimates of decision making frequency for the owner occupier sector have been derived from responses to the consumer survey.[127] These results broadly correspond to other surveys of consumer behaviour.[128,129,130] This suggests using decision making frequencies for cavity wall

[125] Where the year 1 bill saving exceeds the Green Deal charge in year 1.
[126] The other characteristics of the offer to consumers are largely determined and described by the assumptions set out in Annex A.
[127] Respondents were asked if they had taken up or considered taking up a insulation measure in the past 12 months.
[128] Energy Saving Trust (2010) "Trigger points: a convenient truth: Promoting energy efficiency in the home". p5. 22% of homeowners were considering a refurbishment, 85% of whom (i.e. 19% of all homeowners) would consider stretching their budgets to install energy efficiency measures within 3 years.
[129] BERR (2008) "The growth potential for Microgeneration in England, Wales and Scotland", p 29. 14% of respondents considered installing insulation in the previous year.
[130] One discrepancy is the proportion considering cavity wall insulation appears to be higher than in the earlier surveys. This is plausible since the survey was carried out in early 2011; this is a period towards the end of the

insulation of 26% per year for owner occupiers relating to cavity wall insulation and 6% for solid wall insulation. This decision making frequency is expected to vary over the Green Deal period for several reasons.
Customers will become increasingly familiar with solid wall insulation, currently a relatively new measure with around 100,000 expected to have been installed by 2013. The consumer survey found that 15% of those with solid walls were unaware that the measure was a possibility; the corresponding figure was around 3% for cavity wall and loft insulation. Increased consumer awareness is assumed to therefore increase the decision making frequency to around 8%.

The high level of decision frequency observed for cavity wall insulation results from the activity of energy companies under the Carbon Emissions Reduction Target[131]. It is expected that under the Energy Company Obligation this activity will switch to the promotion of solid wall insulation, as cavity wall insulation is proposed as a qualifying measure in limited circumstances only.

Further to this there are several other potential supporting policies that are expected to increase the number of circumstances where householders consider Green Deal home improvements. This includes anticipated promotional activity by Green Deal providers and energy companies in combination with a government sponsored independent advice service that are expected to increase customer awareness and confidence in Green Deal opportunities beyond that found amongst respondents to the 2011 survey. In addition, other policies such as the roll out of smart meters, improvements to energy performance certificates, the renewable heat incentive and feed-in-tariffs provide an opportunity to encourage consideration of domestic energy efficiency improvements and the Green Deal financing mechanism.

To reflect the combination of consumer awareness, additional supporting policies and energy company activity the demand scenarios are based on a range of decision making frequencies for solid wall insulation; from 5% (low) to 10% (central) and 15% (high).

### *Customer Choice Coefficients*

Consumer choice coefficients were derived from responses to a "stated preference exercise". This exercise involved each survey respondent being asked to pick one of four improvement packages. Each "forced choice" was followed by a question about whether they would take up the package they had selected. This design enabled the collection of information about choices between attributes for a larger range of consumers, whilst still providing results that enabled actual uptake to be estimated.

Each respondent was offered around 6 sets of choices of different packages, each with different attributes. Some of these packages would require subsidies to deliver the net bill savings presented to the respondents. The range of packages tested therefore implicitly included a range of subsidies.

---

CERT period when suppliers activity in promoting Cavity wall insulation is likely have been concentrated over a smaller number of remaining unfilled cavities.

[131]Around 1.5m Cavity wall insulation measures have been delivered by suppliers in the period 2008-2010 under the CERT scheme, see,
http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/CU/Documents1/CERT%20newsletter%20issue%2012%20June%202011.pdf

The baseline estimates reflect the weight placed by respondents to the survey on each of the characteristics that was tested. These were derived by regression to fit a "logit" utility function to the choices made by respondents. The resultant coefficients are summarised in Table 45. Models were tested for a range of different consumer segments including:

- Environmental attitudes ("I'm environmentally friendly in most or all the things I do");
- Solid wall versus other measures;
- Moving house within 3 years;
- Owner occupier / private renters;
- Household income;
- "Likely to take up the Green Deal";
- Respondents who find their home "hard to heat"; and
- A vulnerable and low income group versus non-vulnerable group.

Of the variables tested, splitting the sample according to the low income and vulnerable group provided the largest improvement in the model fit while allowing the calculation of statistically significant coefficients for all of the Green Deal attributes.

The first set of coefficients describes characteristics of the package that exist for all measures: the possibility for upfront payment of a share of the costs was included in the survey, as well as attributes covering the assessment costs, the net energy bill savings, and the length of the repayment term.

The second set of attributes describes the consumers' attitudes towards the measures themselves. Measures were presented in the survey alongside descriptions of the impact on the house and living space in terms of changes in appearance or usable floor area, along with additional household time or hassle that may be experienced during installation. These provide a combined "bias" against a measure and the associated hassle cost for each measure. The "biases" against solid-wall insulation were generally much larger than for other measures, which might be expected as they represent more significant changes to a building's fabric and imply a larger degree of hassle associated with installation.

**Table 45 Consumer coefficients**

| Characteristics of package | Consumer coefficients | |
|---|---|---|
| | Affordable Warmth group | Other households |
| Upfront cost (£) | -0.0003 | -0.0003 |
| Assessment cost (£) | -0.0005 | -0.0003 |
| Savings - fixed interest risk (£) | 0.0017 | 0.0034 |
| Savings - variable interest risk (£) | 0.0013 | 0.0031 |
| Repayment - 5 years | 0.0000 | 0.0000 |
| Repayment - 10 years | -0.1167 | -0.1230 |
| Repayment - 20 years | -0.1443 | -0.3394 |
| Repayment - 25 years | -0.1186 | -0.3632 |

| | | |
|---|---|---|
| SWI internal | -2.5500 | -2.1666 |
| SWI external | -2.1546 | -2.0644 |
| CWI | -1.4522 | -1.3087 |
| Loft top up | -1.1467 | -0.8613 |
| CWI + boiler | -1.8325 | -1.4628 |
| Loft top up + CWI | -1.5382 | -1.3866 |

### *Diagnostic Testing*

For the individual coefficients in the final choice model, 25 out of the 32 parameters used (16 each for the priority and non-priority group datasets) were statistically significant with p-value <0.05. The non-significant parameters were retained in the model since excluding them (i.e. setting their value to zero) would create implausible responses for 1 or 2 out of the 10 measures.

A true $R^2$ value does not exist in logistic regression, but there are numerous possible methodologies that can be employed instead.

In this case, for testing overall model fit, a log likelihood score for the chosen model was calculated. This can be compared with the log likelihood value from a 'null model', one that includes only the constants for each technology but no other parameters. When this was done the choice model specification implemented in the Green Deal model resulted in a statistically significant improvement in the goodness of fit relative to the null model.

### *The Utility Function*

The probability of uptake of a given measure is = 1 / 1-$e^{-z}$ where z, the utility function, is calculated by combining the above coefficients as follows:

**z** = calibration coefficient* **(**
( ( upfront installation cost) * upfront cost coefficient)
+ (assessment cost * assessment cost coefficient)
+ ( net bill saving * bill savings coefficient)
+ ( length of repayment period coefficient )
+ ( measure coefficient )**)**

Where net bill saving =
( the bill saving delivered by the measure * future value of bill savings )
- ( annual Green Deal repayment * future value of repayments )

This methodology is illustrated in Table 46 for three example households (it is assumed that the golden rule is met in all cases). This is based on a flat nominal charge and excludes upfront costs (and upfront assessment costs) for explanatory purposes.

**Table 46 Progress of steps to calculate insulation measure uptake in the GDHM**

| **Inputs** | | | |
|---|---|---|---|
| Wall type | Solid Int | Solid Ext | Cavity |
| House Stock | 100,000 | 100,000 | 100,000 |

| Tenure | Owner Occupied | | |
|---|---|---|---|
| Bill Saving (**A**) | £560 | £135 | £314 |
| Amount $CO_2$ saved ($tCO_2$) | 74.52 | 70.56 | 48.72 |
| Subsidy level (@ £80 pa per $tCO_2$) | £5,962 | £5,645 | - |
| Installation cost | £8,147 | £10,650 | £500 |
| Entire cost (includes assessment costs, Green Deal mechanism costs) | £2,185 | £5,005 | £500 |
| Repayment term | 20 | 20 | 10 |
| Yearly repayment (includes cost reduction from subsidy) (**B**) | £214 | £491 | £73 |
| **Consumer choice model** | | | |
| Calibration coefficient (**C**) | 2 | 2 | 2 |
| Future value per £ of bill saving (£) (**D**) | 1.3689 | 1.5293 | 1.3898 |
| Bill saving coefficient (**E**) | 0.00341 | 0.00341 | 0.00341 |
| Future value of £ of rise in repayment (**F**) | 1.1961 | 1.1961 | 1.0798 |
| Repayment term coefficient (**G**) | -0.3394 | -0.3394 | -0.1230 |
| Measure coefficient (**H**) | -2.1666 | -2.0644 | -1.3087 |
| **Utility calculation** | | | |
| **'Utility'** = C * [ (( A * D - B * F ) * E ) + G + H ] | **-1.5322** | **-7.4042** | **-0.4235** |
| **Exponent of Utility Function** | | | |
| This measure | 0.2160 | 0.0006 | 0.6547 |
| **Exponent of Utility Function including other eligible measures** | | | |
| Int SWI | **0.2160** | 0.1500 | |
| Ext SWI | - | **0.0006** | |
| CWI | - | | **0.6547** |
| Loft | - | | 1.5947 |
| 'Do Nothing' | 1 | 1 | 1 |
| **Uptake Share** | | | |
| Int SWI | **17.8%** | 13.0% | - |
| Ext SWI | | **0.05%** | - |
| CWI | - | - | **20.1%** |
| Loft | - | - | 49.1% |
| 'Do Nothing' | 82.2% | 86.9% | 30.8% |
| | | | |
| Decision making frequency (DMF) | 10% | 10% | 26% |
| **Total number of installations (uptake share x DMF x house stock)** | | | |
| Int SWI | 1,777 | 1,304 | - |
| Ext SWI | - | 5 | - |
| CWI | - | - | 5,239 |
| Loft | - | - | 12,760 |
| No uptake | 98,223 | 98,691 | 82,001 |

There are several reasons for why these coefficients may not be representative of the ultimate preferences of those who are offered Green Deal packages:

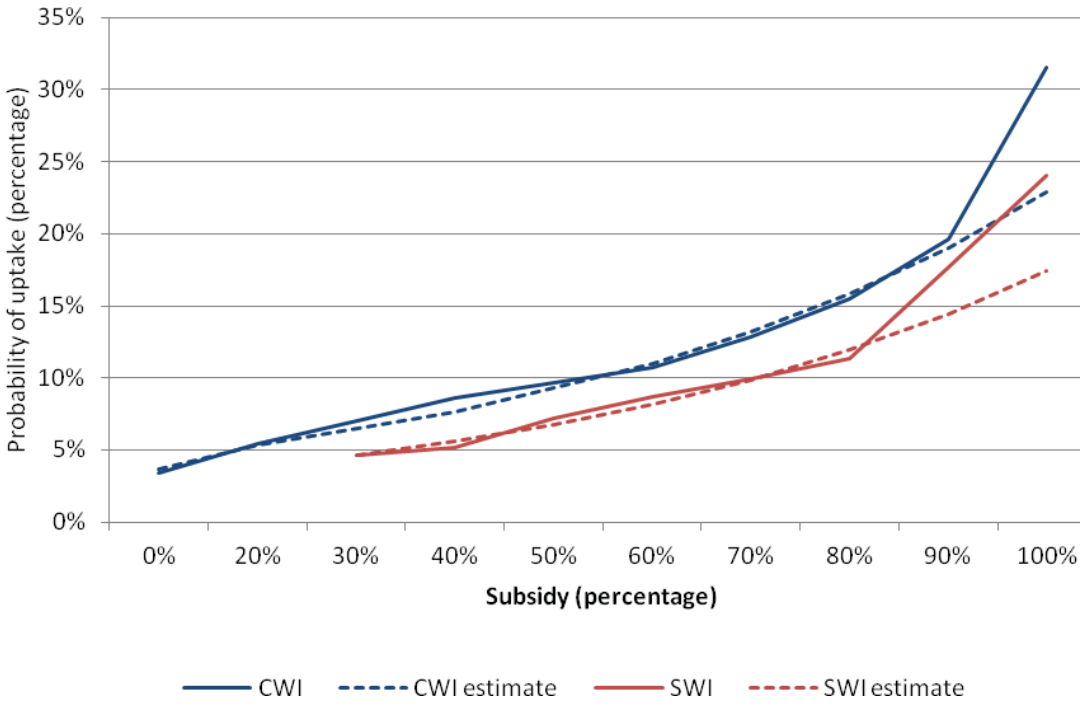
- The survey tested "white label" products rather than "market ready" products that will have been designed to appeal to consumers in different situations;
- The survey was based upon a limited range of choices and characteristics. In reality providers will be able to offer products that differ in other ways, and present those differences to consumers;

- The possibility of subsidies was not explicitly mentioned;
- The market is likely to target its activity on those more likely to respond; however, the survey attempted to capture a cross section of all private households;
- Estimates assume 100% awareness of the Green Deal: if awareness levels are lower, then uptake levels will be lower;
- Estimates are a snapshot in time based on respondents' current financial, economic and household situation;
- Estimates will be sensitive to changes in the economy, interest rates, etc.;
- Estimates may be influenced by good/poor reputation, word of mouth, press, marketing, etc; and
- The reputation of the Government as a supplier of information/accreditation as well as the partners providing the work will all impact consumer preferences.

### Customer Choice Coefficients at High Levels of ECO Subsidy

An additional consumer preference survey was carried out to investigate the supposition that high rate of subsidy has a proportionally larger impact on consumer uptake (see annex L for more details). The first survey suggested that 32% of respondents would be more likely to make their home more energy efficient if subsidies or grants were available, but the possibility of subsidies was not mentioned and the highest implicit subsidy offered in the conjoint experiment was 80%. The additional survey asked similar questions to the original survey, but also asked consumers whether they would take up CWI or SWI given different levels of subsidy (and corresponding net bill savings). The results indicated that high rate of subsidy did have a particular impact of uptake and shown in Figure 34 below

Figure 34 Relationship between subsidy rates and consumer demand for insulation measures




By comparing the actual results with a prediction based on the lower rates of subsidy the following relationship was established.

- For SWI, for each ECO subsidy percentage point above 80%, the take-up is estimated to be 1.9% higher than it would otherwise have been by extrapolating the initial bill saving coefficients (for a maximum of 38%)
- For CWI, for each ECO subsidy percentage point above 90%, the take-up is estimated to be 3.5% higher than it would otherwise have been by extrapolating the initial bill savings coefficient (for a maximum of 35%)

These high-subsidy coefficients were incorporated by increasing the estimated sales by the appropriate amount for each housing type where the ECO subsidy is higher than 80% (SWI) or 90% (CWI).

### Supporting Policy in the Private-Rented Sector

Supporting policy in the private rented sector is assumed to increase uptake in all PRS homes that are rated below the minimum standard (E rating). The Energy Act 2011 enables Government to regulate to help ensure the take up of cost effective energy efficiency improvements in the Private Rented Sector. Government's intention is that:

- from April 2016, domestic landlords should not be able to unreasonably refuse requests from their tenants for consent to energy efficiency improvements, where financial support is available, such as the Green Deal and/or the Energy Company Obligation; and
- from April 2018, all private rented properties (domestic and non-domestic) should be brought up to a minimum energy efficiency standard rating, likely to be set at EPC rating "E". This requirement would be subject to there being no upfront financial cost to landlords. The intention is that landlords would have fulfilled this requirement if they had either reached "E" or carried out the maximum package of measures funded under the Green Deal and/or ECO (even if this does not take them above an "F" rating).

To reflect this in the central modelled scenario an adjusted decision making frequency has been applied to all F and G rate private rented sector properties. This reflects the rate at which landlord will act in anticipation of the regulations coming into force in 2017, and the rate at which they will be required to comply with the regulation after 2017. The assumption is based on the turnover of private rented tenants. The decision making therefore increases from 2013 to 2017 and then remains constant at 35%.

Furthermore F and G rated PRS households are assumed to undertake at least one of the options available to them that meets the Golden Rule (their choices are split proportionately among all Golden Rule compliant choices in accordance with the utilities that would have applied were the home modelled as part of the owner occupied sector). Within the model this is achieved by removing the 'do nothing' option from these housing types. This does not reflect the 'tenant requests' element of the regulations.

Monitoring, enforcement and sanctions for compliance with the PRS regulations is yet to be determined, so a working assumption of 75% compliance has been used. This assumption reflects exemptions as well as non-compliance, and is made solely for the purposes of modelling Green Deal uptake in the Green Deal Household Model. Exemptions will be set in secondary regulations, and a

full Impact Assessment will accompany the consultation on PRS secondary regulations when further details on the possible exemptions are known.

### Supporting Policy in the Social Housing Sector

The social housing sector has historically been active in undertaking energy efficiency improvements under previous energy efficiency schemes. A number of Local Authorities and Social Housing Providers have expressed an interest in the Green Deal as a mechanism for further improvements. In addition improvements in the Local Authority housing stock are likely to contribute to requirements of the Home Energy Conservation Act (HECA). To model this increased likelihood of social housing take-up, the social sector is modelled by assuming that 100,000 SWI and 140,000 CWI 'decisions' are made each year, i.e. the decision making frequency is set each year to equal 100,000 or 140,000 as a percentage of the untreated housing stock at the beginning of that year. The social housing associations are assumed to take-up of at least one of the packages if it meets the Golden Rule.

### Expected Net Bill Savings

The GDHM uses an adjusted value of energy savings to consumers to reflect consumers expectations of likely increases in energy retail prices. The annual bill saving is scaled up to reflect the weighted average discounted retail price of the relevant fuel over the lifetime of the measure[132].

Consumers are assumed to discount these future energy price using a "quasi-hyperbolic" discount rate. This involves using discount rate of 9% but reducing the discount factor to 60% for all benefits beyond year 1[133].

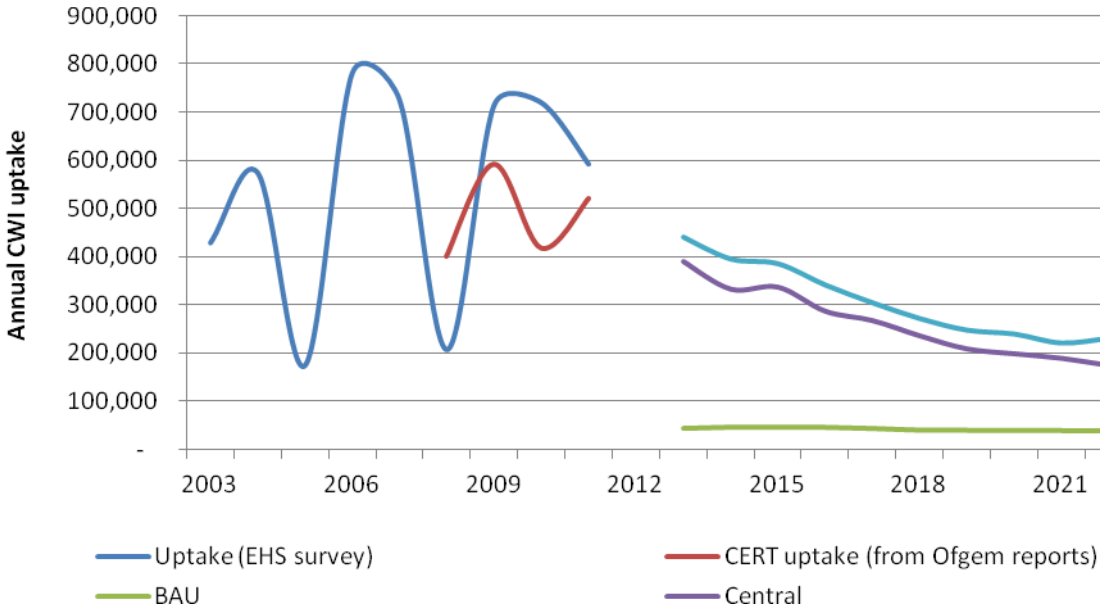
### Calibration of demand scenarios.

The Green Deal uptake scenarios cannot easily be calibrated to historical sales because current polices such as CERT are structured differently, permitting delivery of a wider range of measures than is proposed for ECO. Solid wall insulation has yet to be extensively promoted to owner occupiers under CERT, and loft insulation has been focussed on lofts with lower baseline levels of insulation and therefore these installations offer better value than those taken up under ECO/Green Deal. The most similar measure that can be modelled is cavity wall insulation. The chart below presents the historical sales of CWI and the levels predicted by the model.

[132] These are based on the projected retail prices stated in the supplementary Green Book guidance on valuing changes in energy use. Whilst consumers are assumed to be long sighted in this scenario, they are assumed to have a private discount rate of 9% per year in nominal terms. This is 2 percentage points higher than the consumer interest rate assumed in the central scenario.

[133] This model of quasi-hyperbolic discounting is used by, Laibson, D. (1997): "Golden eggs and hyperbolic discounting", The Quarterly Journal of Economics, 112(2), 443:77.

Figure 35 Historical and projected uptake of CWI




## Green Deal Finance Cost Calculations

The modelled Green Deal finance costs are achieved by first calculating the *entire* installation cost. This consists of the installation cost of the package as well as the assessment cost, the Green Deal set-up cost, and the annual Green Deal administration cost. See Annex A for more details on these quantities.

The Present Value of the annual Green Deal administration cost is calculated for each measure at the appropriate interest rate and loan repayment period, and this is added along with the assessment and set-up costs to the Installation cost.

It is from this entire cost starting point that the optimised ECO subsidies are subtracted for each measure / housing type, leaving the amount of Green Deal finance; see example below:

Table 47 Example Green Deal finance cost calculation

| Installation Cost | Assessment Cost | Green Deal Set-up Cost | Green Deal Annual cost | PV (annual cost @ 7.5% interest, 20 years) | Entire Cost | ECO Subsidy | Green Deal Finance amount |
|---|---|---|---|---|---|---|---|
| £6,000 | £112.5 | £16 | £8 | £81.56 | £6,210 | £3,000 | £3,210 |

## Energy Company Obligation

Different elements of the obligation are modelled separately.

1. The Carbon Saving and Carbon Saving Communities targets – carbon emissions reductions achieved through the installation of insulation in all homes
2. Affordable Warmth via insulation measures – installation of loft and cavity wall insulation in homes that count towards the Affordable Warmth target.

3. Affordable Warmth via heating measures.

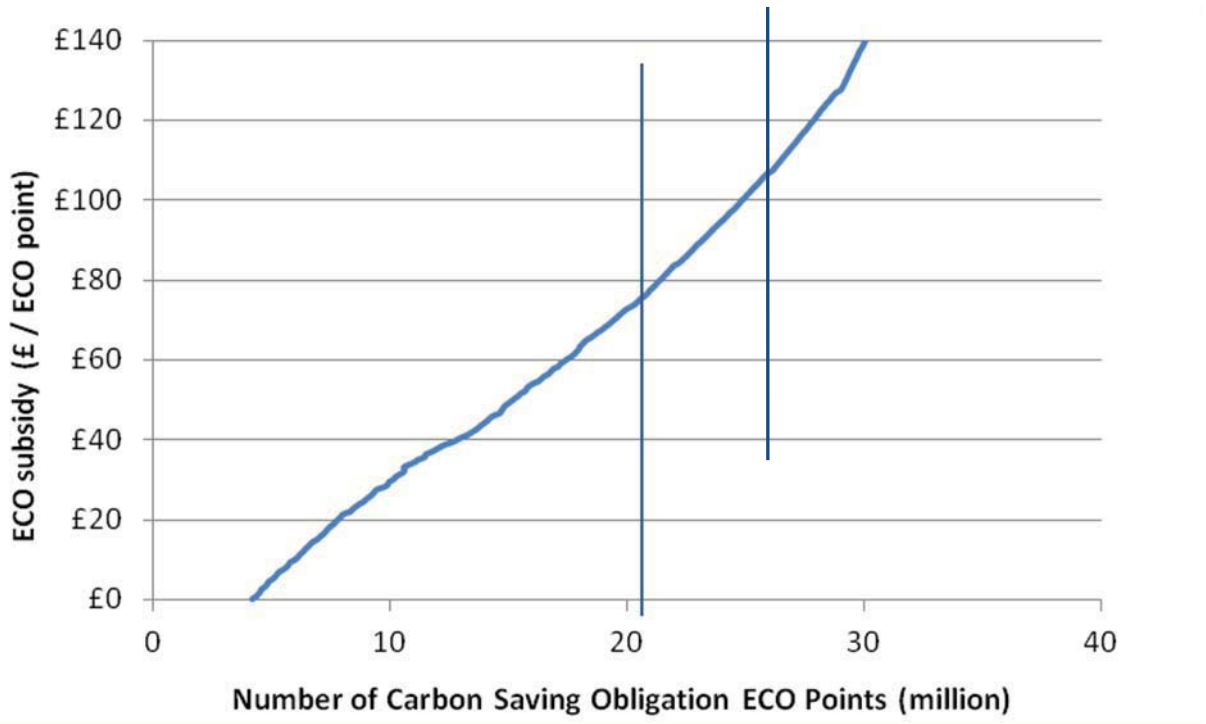
Element 1 is modelled using the GDHM with Elements 2 and 3 being modelled as described in Annex D.

The ECO Carbon targets are modelled as a subsidy offered to consumers that reduces the annual Green Deal repayment. The GDHM works by analytically setting the optimal subsidy for each of the 3,866 housing types. To achieve this, ECO point supply curves are derived. The model iterates upwards from £0, in steps of £25 per ECO point (lifetime $tCO_2$ saving), calculating:

a) *For each housing type* the subsidy per measure for a given subsidy per ECO point (i.e. a SWI that saves 1.2 $tCO_2$ will receive £120 if the subsidy is £100 per ECO point)
b) the uptake of measures (i.e. number of installations) resulting from that level of ECO subsidy
c) the total amount spent given the total number of ECO points

The model increases the ECO subsidy per point and recalculates the number of installations and total cost of installations. This process is repeated until the full supply curve has been calculated. The model then selects £ per ECO point subsidy that corresponds to the carbon target for that interim period. The targets will be fixed for the first interim period, but will be revised for the following periods in 2015 and 2018. The sensitivity analysis therefore uses the central carbon targets for the first interim period, but uses revised targets in the second and third periods, to reflect reviews in 2015 and 2018.

**Figure 36 Central ECO point supply curve for Carbon Saving target ($CO_2$)**




The optimised ECO subsidy enters into the consumer uptake function as described above by reducing the annual Green Deal repayment that consumers face. Higher subsidies result in higher

net bill savings for the consumer and the measure is therefore more attractive, thus increasing the utility function for that measure and consequently the take-up.

The cost of the total obligation is based on the subsidy required to deliver the target. The ECO Carbon Target is modelled as three interim targets (2013-2015, 2016-2018 and 2019-2022) and the target is based on the each interim target as a whole. The inter-temporal pricing of ECO points is assumed to incorporate of cost of carry of 9%. A subsidy rate of £100 / tCO2 point in 2015 therefore corresponds to a subsidy rate of £91.7 in 2014 and £84.2in 2013. This leads to higher uptake in the later periods of each interim target.

### Additional Measures - Uptake of Insulation Packages

The Green Deal and ECO consultation document set out the Government's vision of a whole-house approach to energy efficiency being adopted, where households are encouraged to install a package of measures, as opposed to just one measure on its own. The GDHM functionality has been improved to better account for this whole house approach, and the assumptions for the uptake of packages are described below.

There are a number of reasons why a household may choose to install a package of measures, and why government would want to support this sort of approach, as:

- it would allow measures to be delivered more cost effectively as some of the fixed installation and hassle costs would be spread over a larger number of measures;
- it would allow improvements to be tailored to one another avoiding, for example, an expensive, high output heating system being installed just before the heat requirements of a house drop due to a package of insulation being installed; and
- the decision making frequency of households for installing energy efficiency measures is low, meaning a whole house approach could guarantee a greater roll-out of energy efficiency measures[134].

Whether a household chooses to install a package of measures will depend on their preference for the measures, the cost of the package, how much of the package can be Green Deal or ECO financed and whether they have access to alternative sources of capital. The marginal decision associated with installing additional measures would be based only on the installation cost associated with the measure, and would not include the Green Deal mechanism costs which would have been incurred for the installation of the first measure.

Table 49 below shows that draught-proofing, new or replacement storage heaters and floor insulation all appear to be attractive package measures to install using Green Deal finance (column H). It also illustrates that, of the main insulation measures, only easy to treat CWI attracts an amount of Green Deal finance greater than the total cost of installation. This headroom could be used to cross-subsidise measures and makes CWI a possible trigger for the uptake of a package of measures.

[134] For example, around 26% and 24% of respondents to the consumer insight survey accompanying the consultation said they would only consider installing energy efficiency measures 4-10 years and 10 years or more after moving into a house. See http://www.decc.gov.uk/assets/decc/11/consultation/green-deal/3503-green-deal-consumer-research-topline.pdf.

Under the ECO, floor insulation, loft insulation and draught-proofing appear to be attractive measures to package alongside SWI or HTT CWI as the ECO subsidy received for these measures would exceed their cost of installation. That is, some of the ECO subsidy could be used to reduce the cost associated with installing SWI. In addition, whilst the ECO subsidy available for glazing as a proportion of its cost is low, the absolute figure is high. It is expected that there will be a high take up of glazing in the business as usual scenario driven by building regulations and therefore the Green Deal and ECO are not assumed to drive additional uptake of glazing (see section above).

These arguments, along with information on the technical potential and hassle costs associated with each possible package measure, have been factored into the uptake calculations in the GDHM and are summarised below. The technical potential figures have been calculated using data from the EHS, looking at the proportion of un-insulated cavity wall and solid wall properties which also have the technical potential for the package measures considered. This has been multiplied by a preference factor to determine the uptake factor in column D.

**Table 48 Package assumptions for GDHM**

| Measure | Technical potential as proportion of main insulation stock | "preference factor" (% of households offered which take up measure) | Proportion installed |
|---|---|---|---|
| **Packaged with CWI using Green Deal finance** | | | |
| **Flue gas heat recovery (with boilers)** | **20% of boilers are packaged with flue gas heat recovery** | | |
| Draughtproofing (with CWI) | **6%** | **80%** | **5%** |
| Loft insulation (with CWI) | Package included in the GDHM | | |
| **Packaged with SWI accessing ECO subsidy** | | | |
| **Loft insulation (packaged with SWI)** | **27%** | **80%** | **22%** |
| **Draught-proofing and Glazing (packaged with SWI)** | **9%** | | |
| **Floor insulation (packaged with Internal SWI)** | **44%** | **40%** | **18%** |
| **Floor insulation (packaged with External SWI)** | **44%** | **10%** | **4%** |

**Table 49: Energy savings, Green Deal finance and ECO subsidy available for eligible measures**

| Measure | Energy saving (kWh per year) | Installation cost | Total Green Deal Plan cost [1] | Assumed max Green Deal term [2] | Year 1 bill saving | Green Deal finance available for measure | Proportion of total cost (D) which can be Green Deal financed (on own) | Proportion of installation cost (C) which can be Green Deal financed (package) | ECO subsidy available for measure with SWI or HTT CWI | ECO subsidy headroom (installation cost less subsidy available) |
|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K |
| CWI (easy) | 2673 | £500 | £796 | 10 | £133 | £985 | 124% | 197% | £1,599 | £1,099 |
| CWI (hard to treat) | 2673 | £1,875 | £2,171 | 10 | £133 | £985 | 45% | 53% | £1,599 | - |
| Internal SWI | 5494 | £5,300 | £5,623 | 20 | £273 | £3,223 | 57% | 61% | £2,817 | - |
| External SWI | 5494 | £9,950 | £10,273 | 20 | £273 | £3,223 | 31% | 32% | £2,817 | - |
| Loft insulation (top up) | 499 | £300 | £596 | 10 | £25 | £184 | 31% | 61% | £299 | - |
| Non condensing gas boiler to condensing gas boiler in the year 2013. The savings will reduce as the boiler efficiency improves in the future | 1962 | £2,500 | £2,796 | 10 | £97 | £723 | 26% | 29% | - | - |
| Floor insulation | 1084 | £400 | £723 | 20 | £54 | £636 | 88% | 159% | £648 | £248 |
| Heating controls [3] | 495 | £450 | £746 | 10 | £25 | £182 | 24% | 41% | - | - |
| Flue Gas heat recovery (condensing combi boiler) | 666 | £400 | £696 | 10 | £33 | £246 | 35% | 61% | - | - |
| Hot water cylinder insulation (top up) [3] | 417 | £30 | £326 | 10 | £21 | £154 | 47% | 512% | - | - |
| Double Glazing (old single to A) | 2280 | £4,500 | £4,796 | 10 | £113 | £840 | 18% | 19% | £649 | - |
| Double Glazing (C to A) | 190 | £4,500 | £4,796 | 10 | £9 | £70 | 1% | 2% | £54 | - |
| Secondary glazing | 1657 | £1,250 | £1,546 | 10 | £82 | £611 | 40% | 49% | £472 | - |
| Flat roof insulation | 2752 | £1,050 | £1,346 | 10 | £137 | £1,015 | 75% | 97% | £784 | - |
| Room in roof insulation | - | £2,100 | £2,396 | 10 | | - | - | - | - | - |

| Measure | Energy saving (kWh per year) | Installation cost | Total Green Deal Plan cost [1] | Assumed max Green Deal term [2] | Year 1 bill saving | Green Deal finance available for measure | Proportion of total cost (D) which can be Green Deal financed (on own) | Proportion of installation cost (C) which can be Green Deal financed (package) | ECO subsidy available for measure with SWI or HTT CWI | ECO subsidy headroom (installation cost less subsidy available) |
|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K |
| High performance replacement doors | 317 | £1,000 | £1,296 | 10 | £16 | £117 | 9% | 12% | £135 | - |
| Draughtproofing | 649 | £100 | £396 | 10 | £32 | £239 | 60% | 239% | £92 | - |
| Lighting systems and fittings | 97 | - | £273 | 5 | £5 | £20 | 7% | | - | - |
| Cylinder thermostat [3] | 2169 | £300 | £596 | 10 | £108 | £800 | 134% | 267% | - | - |
| New or replacement storage heaters | 1083 | £350 | £646 | 10 | £54 | £399 | 62% | 114% | - | - |
| Replacement warm-air unit | 433 | £1,750 | £2,046 | 10 | £21 | £160 | 8% | 9% | - | - |
| Condensing oil boiler | 0 | - | £296 | 10 | £0 | - | - | - | - | - |
| Under-floor heating | 0 | £5,000 | £5,296 | 10 | £0 | £0 | 0% | 0% | - | - |
| Waste water heat recovery systems | 0 | - | £296 | 10 | £0 | £0 | 0% | | - | - |
| Biomass boiler | - | £9,000 | £9,296 | 10 | £0 | £0 | 0% | 0% | - | - |
| Biomass room heater with boiler | - | - | £296 | 10 | £0 | £0 | 0% | | - | - |
| Solar water heating | 1336 | £4,500 | £4,796 | 10 | £66 | £493 | 10% | 11% | - | - |
| Photovoltaics | 1595 | £12,000 | £12,296 | 10 | £79 | £588 | 5% | 5% | - | - |
| Ground source heat pump [4] | -205 | £12,000 | £12,296 | 10 | -£10 | - | - | - | - | - |
| Air source heat pump | -553 | £7,500 | £7,796 | 10 | -£27 | - | - | - | - | - |
| Micro CHP | - | £5,500 | £5,796 | 10 | | - | - | - | - | - |
| Building mounted wind turbine | 570 | £3,200 | £3,496 | 10 | £28 | £210 | 6% | 7% | - | - |

This table makes assumptions about the characteristics of a property before installing an improvement measure, for example it assumes average building characteristics for a home in 2006 and that heating measures are assumed to replace less efficient systems of the same type. These savings include the adjustments made for inaccessibility and in-use factors. The actual savings will vary and will be determined for the

specific property in the Green Deal assessment. The energy and bill savings and installation costs in this table are for a representative 3-bed semi-detached property with gas central heating. In reality there is a large variation in these figures between different house types. There are therefore a large number of households for which the Green Deal Finance will be able to cover a larger proportion of the costs.

(1) Column D shows the total GD plan cost, which is the cost of the measure, cost of assessment and interest payments associated with the GD plan, reflecting the assumptions which have been used for the GD modelling. This is therefore a present value of all the costs as the interest payments will be paid in the future.

(2) Assumed maximum Green Deal term is less than actual lifetime of measure to reflect consumers' potential aversion to taking out Green Deals with long term repayment schedules

(3) Hot water cylinder insulation and cylinder thermostat savings and heating controls assume nothing is currently present, which overestimates the savings. The savings are therefore uncertain and have not been included in the packages analysis above

(4) The savings for ground and air source heat pumps were derived by comparison with the base case dwelling, with a gas boiler. While this saves energy, the switch from gas to electricity results in greater costs.

(5) Column I illustrates the proportion of the installation cost of the measure that can be financed through the Green Deal when the measure is added to a package of other measures (and so does not include the Green Deal mechanism cost that would have been incurred anyway). Column H shows the proportion of the total package costs that can be financed through the Green Deal when the measure is installed on its own (in this case the Green Deal Finance also has to cover the Green Deal mechanism costs). Column J shows the projected ECO subsidy available when the measure is packaged alongside solid or hard to treat cavity wall insulation. The actual subsidy will depend on a wide range of factors, such as energy company behaviour. Column K

## Green Deal Finance contributions for other measures.

The GDHM calculates the uptake of the main insulation measures as a result of introducing the Green Deal and ECO. However, the Green Deal will also be used to part finance other measures. Two measures that are expected to be sold at scale are boilers and double-glazed windows. The analysis that follows assumes that some of the uptake of these two measures will now be financed by the Green Deal**. The impact of these measure is not included in the NPV of the policy presented in the this Impact Assessment. These measures would be installed if the policy was not introduced and so do not contribute to the energy and carbon savings impact of the policy. They are included for the purpose of estimating the total amount of Green Deal finance only.**

### Boilers

There are currently an estimated 1.5m[135] UK boiler sales in the UK and it is reasonable to assume that most sales would happen in the absence of Energy Supplier Obligations. The main exception is the 100,000 boilers that Warm Front currently delivers and will continue to be delivered through the Affordable Warmth obligation of ECO. It is assumed that a percentage of the remaining 1.4m boilers will be financed by Green Deal finance[136].

It is assumed that only boiler installations that will be condensing boilers replacing non-condensing boilers will produce enough energy savings to be worth the hassle costs of arranging a Green Deal. The number of condensing boilers replacing non condensing boilers has been estimated at 1,075,000 pa in 2013[137] falling to 833,000 in 2016 as boiler efficiency in the housing stock increases over time. A conservative assumption that all Warm Front/Affordable Warmth boilers are/will also be condensing replacing non-condensing, reduces this potential to 975,000 pa in 2013 falling to 733,000 in 2016.

The Green Deal stated preference survey estimates that 6% of people who need a boiler, will use Green Deal finance. This means 64,500 BAU boilers will be financed through Green Deal finance. This is likely to be conservative as business models provided by key providers predict far higher levels of Green Deal finance from boilers than is projected by the GDHM. For that reason we also model a high scenario of 12% choosing to use Green Deal finance. Anecdotal evidence from potential Green Deal providers say that sales are likely to be concentrated within the F and G boilers. The distribution of installations has therefore been weighted relative to the four different non-condensing boiler categories (see Table 50 below). Total volume of Green Deal finance is then given by multiplying remaining boilers by the amount financeable for its respective rating (see table). This gives ***£66m*** pa

[135] Source: extrapolating SEDBUK boiler sales

[136] It should be noted that the CWI and boiler packages the GDHM predicts, are considered additional to the 1.5m business as usual (BAU) and would not be installed in the absence of Green Deal&ECO. They are assumed to be cases where customers are only installing a boiler due to the availability to do so in conjunction with CWI within a Green Deal package. CWI and boiler packages are not considered in this analysis.

[137] Source: difference between 2012 and 2013 condensing boiler numbers obtained by extrapolating SEDBUK boiler sales

in 2013 falling to **£63m** in 2016.[138] In the High scenario this gives ***£132m*** pa in 2013 falling to **£126m** in 2016

**Table 50 Green Deal finance contribution from BAU boilers in 2013**

| | | Boiler rating | | | |
|---|---|---|---|---|---|
| Total number of condensing replacing non-condensing | 975k | D | E | F | G |
| Percent of total installations taking Green Deal finance | 6% | | | | |
| kWh per year | | 1,485 | 2,344 | 3,299 | 5,253 |
| kWh after 25% in use factor | | 1,114 | 1,758 | 2,474 | 3,940 |
| Green Deal Finance per boiler (£) | | 451 | 712 | 1,002 | 1,595 |
| % of condensing replacing non-condensing | | 12% | 19% | 27% | 42% |
| **No. of con rep non-con (000's)** | | 117 | 185 | 260 | 414 |
| **No. of Green Deal installations (000's)** | | 7.02 | 11.08 | 15.59 | 24.82 |
| **Green Deal finance contribution (£000's)** | | 3,164 | 7,884 | 15,616 | 39,593 |
| **Total Green Deal finance(£m)** | | **66** | | | |

**Table 51 Projected Boiler sales and Green Deal finance volume from 2013-2022 taking into account varying energy prices over time**

| | Number of boilers (000s) | Boiler Green Deal finance (£m) |
|---|---|---|
| 2013 | 58.5 | 66.26 |
| 2014 | 58.5 | 71.57 |
| 2015 | 58.5 | 73.36 |
| 2016 | 47 | 63.46 |
| 2017 | 47 | 61.65 |
| 2018 | 47 | 58.29 |
| 2019 | 47 | 59.01 |
| 2020 | 47 | 59.53 |
| 2021 | 47 | 59.66 |
| 2022 | 47 | 59.91 |

## Glazing

5,794,000 double glazed windows are installed each year[139]. Assuming eight windows are replaced in a typical house, this means 725,000 houses (2.8% of GB housing stock) replace windows each year. It is assumed that only windows with poor/no double glazing would access Green Deal finance as upgrading double glazing from C to A rating would only save £100 over its lifetime. The EHS

[138] Note the volume of Green Deal finance also varies over these years due to fluctuating projected energy prices.
[139] D CLG market research

suggests that around 2m English homes have no double glazing. Using the replacement rate for the GB stock, gives a single glazing Green Deal finance potential of 56,000.[140]

The 6% of boiler installations that will use Green Deal finance is considered a lower bound preference factor for windows. Boilers are often distressed purchases to replace broken ones. In such a situation a consumer is less likely to forgo the burden of obtaining Green Deal finance than in a more planned purchase like new windows. A Green Deal finance preference factor of 20% is therefore used for the majority of these window replacements. However, around 1,000[141] of the 56,000 potential will be installing glazing in conjunction with Green Deals for CWI or SWI. An increased Green Deal finance preference factor of 50% is assumed for these consumers as they are more likely to finance glazing if they are already taking out Green Deal finance for CWI/SWI.

This gives a number of windows part financed by Green Deal finance of 11,500. This is conservative as the Green Deal Finance Company (GDFC) projects a higher figure of around 40,000[142]. Total volume of Green Deal finance is then given by multiplying the number of windows by the amount financeable by Green Deal finance (this is assumed to be £1,100 for the majority of glazing but £1,700[143] for glazing packaged with CWI). This gives ***£13m*** pa.

**Table 52 Double glazing window Green Deal finance sale projections pa**

| | All Glazing | Just Glazing | Glazing in conjunction with Green Deal CWI |
|---|---|---|---|
| No. homes with single glazing | 2,000,000.00 | | |
| Replaced pa (assuming 2.8% replacement rate) | 55,712 | | |
| % assumed replaced using Green Deal Finance | | 20% | 50% |
| Number of Green Deal windows | 11,442 | 10,942 | 500 |
| Savings (£) per window | | 1,100 | 1,700 |
| Total Green Deal Finance (£m) | 12.89 | 12.04 | 0.85 |

As such, the boiler and glazing sales contribution to Green Deal finance volume is estimated at an average of **£76m** pa rising to **£139m** pa in the high boiler scenario.

[140] Whilst the possibility of laggards being over represented in this segment of the market is noted, it is hard to quantify and the overall loss from this effect may be compensated by some C to A upgrades.
[141] EHS 2008 estimates 9% of un-insulated cavity and 18% of solid wall properties to have single glazing. Multiplying these percentages by CWI and SWI projected GDHM sales figures and then by the 2.8% replacement rate gives approximately 1,000 homes pa, that could decide to use Green Deal finance for insulation and glazing.
[142] The Green Deal Finance Company assume a degree of additionality as it implies a replacement rate of single glazed windows above that of the current GB stock. Additionality has not been assumed in DECCs calculation.
[143] This includes £600 headroom for Green Deals on CWI that is drawn in by inclusion of glazing.

## Equity Weighting

Equity weights were applied to different costs and benefits to capture the value to households of the inherent transfers associated with the scheme. Equity weights were applied in line with Green Book guidance[144] to the reduction in household energy bills, the comfort taken and to the hidden costs.

The equity weighting associated with each income decile is calculated as the ratio between the marginal utility of consumption for that decile and the average marginal utility of consumption across all deciles. These are calculated in accordance with Green Book guidance using the median level of income in each income decile. The marginal utility of consumption for each income decile is calculated using the Green Book methodology; assuming that the elasticity of the marginal utility is one, then this implies that the utility function is U = log C (where C is consumption). Consequently the marginal utility of consumption is 1/C. In addition it is also assumed that the marginal propensity to consume is one therefore all income is spent on consumption. So for example the marginal utility for the lowest income decile is 1/7500 = 0.000133.

**Table 53 Equity weightings across income deciles**

| Unequivalised Income Decile Group | Average Unequivalised Income (2009) | Marginal Utility of Consumption | Equity Weight |
|---|---|---|---|
| 1 | £7,257 | 0.00014 | 3.84 |
| 2 | £11,112 | 0.00009 | 2.51 |
| 3 | £13,992 | 0.00007 | 1.99 |
| 4 | £17,089 | 0.00006 | 1.63 |
| 5 | £20,718 | 0.00005 | 1.34 |
| 6 | £24,827 | 0.00004 | 1.12 |
| 7 | £29,619 | 0.00003 | 0.94 |
| 8 | £35,679 | 0.00003 | 0.78 |
| 9 | £44,438 | 0.00002 | 0.63 |
| 10 | £73,770 | 0.00001 | 0.38 |
| Average Income: | £27,851 | 4.00E-05 | |

A range of cost and benefit transfers are taken into account. These are:

- Energy bill savings – for households receiving 100% ECO subsidy
- Energy bill savings – from future energy price rises for households receiving Green Deal measures
- Comfort taking
- The interest on the Green Deal charge
- ECO pass through cost onto consumer bills
- The economic surplus associated with the ECO subsidy
- Hidden costs to the householder

Installation costs under Green Deal and social benefits have not been considered for equity weighting as they are an investment and return to society and do not represent a transfer from one

[144] Page 91 of the Green Book: http://www.hm-treasury.gov.uk/d/green_book_complete.pdf

section of society to another. There are also a range of groups that are considered with a different distribution of the costs and benefits. The table below presents the spread across the different income groups under these different groups.

Table 54 Spread of benefiting households across income deciles for an illustrative vulnerable group proxy

| Income Deciles | Affordable warmth group[145] | Non-Affordable Warmth group | Carbon Saving obligation group[146] | Distribution of ECO costs |
|---|---|---|---|---|
| **1** | 0.15 | 0.09 | 0 | 0.07 |
| **2** | 0.23 | 0.08 | 0 | 0.08 |
| **3** | 0.22 | 0.08 | 0 | 0.09 |
| **4** | 0.2 | 0.09 | 0.14 | 0.1 |
| **5** | 0.11 | 0.10 | 0.14 | 0.1 |
| **6** | 0.05 | 0.11 | 0.14 | 0.1 |
| **7** | 0.02 | 0.11 | 0.14 | 0.11 |
| **8** | 0.01 | 0.11 | 0.14 | 0.11 |
| **9** | 0.01 | 0.11 | 0.14 | 0.11 |
| **10** | 0 | 0.11 | 0.14 | 0.12 |

The benefits and costs accruing to each decile subsequently receive the relevant equity weight and are summed across income deciles to represent the total equity benefit or cost. The net equity impact is then gained by subtracting from these totals the un-weighted hidden cost and comfort taken respectively, to avoid double counting the benefit or cost in the NPV figures.
The net equity impact hence represents the additional value of the benefit or cost to the household over the un-weighted value included in the un-weighted NPV.

## Equity weighted energy bill savings

These benefits differ for separate parts of the ECO and Green Deal.

The first group  is the Affordable Warmth group. It is assumed that this group will receive 100% ECO subsidy and thus will have energy bill benefits from year one. The total energy bill benefits for the lifetime of the measure are considered. These benefits are then assumed to be spread across the income deciles for households within the Affordable Warmth group before being multiplied by the

[145] Spread of CWP and CTC <£16k across deciles
[146] This differs from the non-affordable warmth group as it assumes that no households below income decile 4 receive a measure.

income equity weightings and the difference between these and the non-equity weighted savings are presented.

The second group of energy bill savings is for homes receiving measures under the Green Deal and therefore not receiving a bill reduction in year one. However, due to expected energy retail price increases over time they will see future bill savings as a result of lower consumption. These bill savings are assumed to be spread across the non-Affordable Warmth group and the same methodology is followed.

### Equity weighted hidden cost and comfort taken

The estimated hidden costs and comfort taken are distributed between income deciles according to the estimates of who receives measures – the table above presents this distribution for the Affordable Warmth and non- Affordable Warmth groups.

### Equity weighted interest of the Green Deal charge

The interest of the charge is seen as a cost to households receiving Green Deal, however the benefit is faced by banks and their shareholders. This is then considered as a cost using the non-Affordable Warmth distribution, but the benefit is assumed to be distributed across all groups equally (assuming that shareholders are spread equally across society). The net result is the difference between the two.

### ECO pass though onto consumer bills

It is assumed that all consumers will see bill increases as a result of funding the ECO. This is expected to be passed on as set out in Annex H. The difference between the equity weighted and non-equity weighted numbers will be used as the net equity weighted ECO bill increase impact.

### Economic rent associated with the ECO subsidy

The economic surplus results from ECO subsidy level for each measure being set at the market clearing rate (see ECO mechanism cost section of main IA). This surplus will therefore be a transfer from household energy bill payers to either households receiving measures or installers/energy companies. This IA assumes that the households are beneficiaries of the surplus, and that this sruplis accrue to the carbon obligation group as low income and vulnerable homes are unlikely to have sufficient the bargaining power to ensure they receive the benefit. As the cost of the transfer is spread across all household bills the equal distribution group is assumed. The net equity weighted impact is the equity weighted benefit minus the equity weighted benefit.

# Annex C: The Non-Domestic Model

## Overview

Two separate models have been used to determine the impacts of the non-domestic Green Deal in this Impact Assessment. The first models the voluntary take-up of energy-efficiency financed through the Green Deal amongst the whole non-domestic building stock; the second models the impacts of a supporting policy of regulation of the private rented sector's (PRS) least efficient properties, requiring an improvement in their Energy Performance Certificate (EPC) rating. These models are run sequentially, with the outputs of the former feeding into the latter. This ensures that only the additional impact of the PRS supporting policy is accounted for. The models are described in turn below.

Three scenarios are modelled, which are characterised as follows:

- The **low** scenario assumes that there are preferences for quick pay-back bundles whenever these are available. If there are bundles that deliver greater savings over time, but do not pay back as quickly, then these are not taken up in the low scenario. It is also assumed in this scenario that there is some supporting policy in the private rented sector (PRS), but that a significant proportion of savings covered by this policy would not be deliverable in practice.

- The **central** scenario represents our best estimate of the impact of the Green Deal and supporting policies in the non-domestic sector. There is a tendency for consumers of Green Deals to have varied preferences when it comes to payback periods, but with a general tendency towards quick payback options[147]. In this scenario, it is also assumed that there is some supporting policy in the PRS targeting F and G EPC-rated buildings, although there are limitations regarding the deliverability of this. These limitations relate to the number of exempted buildings, the number of buildings with long leases, and the level of non-compliance with the regulations.

- The **high** scenario is characterized by consumers preferring more comprehensive bundles, regardless of payback period, so long as the bundles pay back at some stage. This delivers a much higher level of savings, but requires a much bigger commitment from consumers. The scenario also assumes that there is good supporting policy in the PRS, requiring that all F and G EPC-rated buildings are required to improve their rating to at least an E whenever it is cost-effective to do so. Within this, it is assumed that a significant proportion of this is paid for with Green Deal finance, and that there are few buildings on which the policy will not have an impact.

## Non-Domestic Voluntary Model

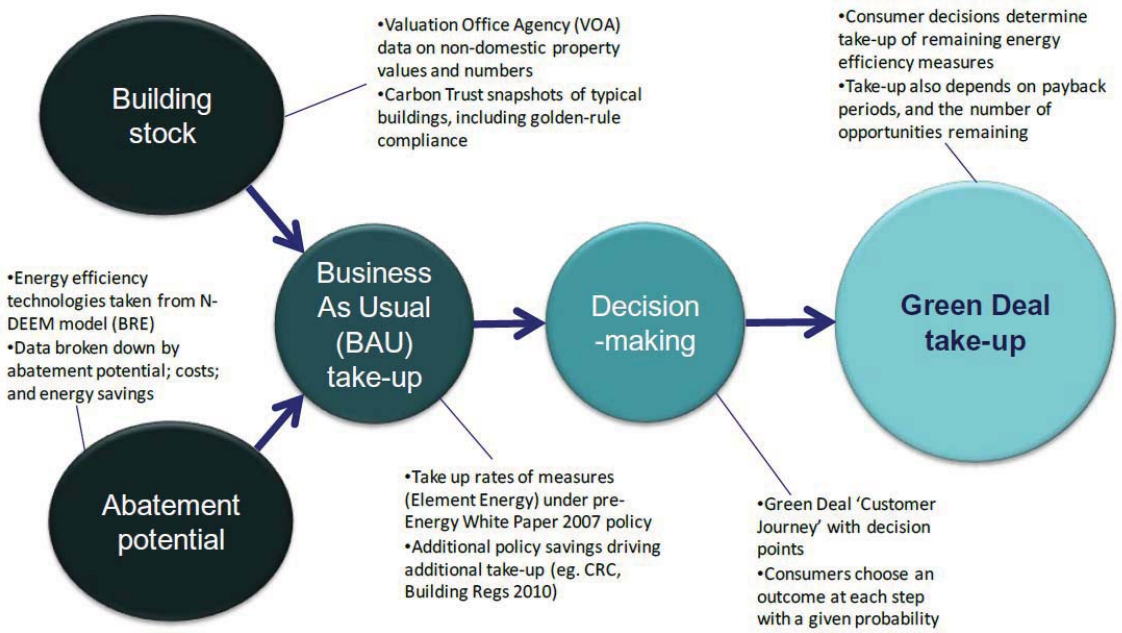
This model is used for the analysis of the impacts resulting from the voluntary take-up of the Green Deal in the non-domestic buildings sector. It takes as a starting point the likely cost-effective abatement potential of buildings by type of measure; it determines which measures are likely to

[147] From the Green Deal Business Survey: 12% of respondents said a payback period of less than 3 years would make them less likely to invest in Energy Efficiency, whereas this figure is 28% for 3-10 year payback and 39% for 10-25 year payback.

meet the Golden Rule to qualify for the Green Deal , then looks at the likelihood of different agents in the sector deciding to undertake a Green Deal.

The figure below presents the relationship between the various elements that contribute to the modelling. The main components of the model are summarised as follows:

**Figure 37 Overview of the Green Deal modelling process**




## Building Stock Suitable for Green Deal Measures

Analysis commissioned by the Carbon Trust, from AEA[148] identified a sample of typical, but hypothetical, properties in different commercial sectors and assessed the bundles of measures that would be eligible for a Green Deal, based on compliance with the Golden Rule. For this work 20 snapshots were assessed, representing some of the most significant contributors to emissions in the non-domestic sector. The selection of snapshots was determined through a consideration of several factors including the stock of buildings in the sector, the aggregate 'unconstrained'[149] energy consumption of buildings in the sector, and AEA expert judgement. The snapshots included are listed in the table below.

[148] Analysis of Green Deal measures – payback in the non-domestic sector, with separate Excel spreadsheet, http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx

[149] Those emissions not covered by the EU ETS, CRC Energy Efficiency Scheme, and Climate Change Agreements.

Table 55 Properties included in AEA analysis

| | |
|---|---|
| Small office | Hotels and catering - Hotel in listed building |
| Medium office, single occupancy | Air conditioned prestige hotel |
| Medium office, multiple occupancy 1 floor on large building. | Small food shop |
| Large office including data centre | Medium size store in outlet centre |
| School in one medium sized building | Medium department store |
| Medium multiple building school | Large supermarket |
| Surgery (small building) | Medium sized leisure centre with swimming pool |
| Hospital (large building) | Heated warehouse - medium size. No cooling |
| Hotels and catering - Pub | Small industrial unit (light manufacturing) |
| Hotels and catering - B&B | Medium industrial unit |

The specifications of each of these snapshots were determined according to judgement of what constitutes a 'typical' set of characteristics for the building, including size; age; building materials; occupancy; energy bills; and typical fabric. Following this, a choice of energy savings measures was determined, based on the relevance to the building; the speed of payback; the Green Deal eligibility criteria; and the need to consider a portfolio of savings measures. The energy savings and costs associated with these measures were also assessed. For each of these snapshots, the potential Green Deal measures were grouped into bundles to represent choices of energy savings packages that could be adopted under a Green Deal. Finally, these properties, bundles and measures are then aggregated by the non-domestic Green Deal model to determine the stock of buildings and Green Deal opportunities in the sector.

Data from the Valuation Office Agency (VOA) gives the number and rateable value of buildings by sector in the year 2010, to a substantial level of disaggregation. This information is used to provide a framework for aggregating specific snapshots of eligible buildings to a Great Britain total.

### Business As Usual Profile of Measure Take-Up

The scale of abatement potential from Green Deal-type measures (those that are fabric measures that meet the Golden Rule) is estimated using the National Non-Domestic Buildings Energy and Emissions Model[150] (N-DEEM), together with technology penetration rates as estimated by Element

[150] NDEEM was developed by the Building Research Establishment to provide an insight into energy use and abatement potential within the country's non-domestic properties. Christine Pout: "N-DEEM: The national non-domestic building energy and emissions model – an overview," in: Environment and Planning B: Planning and Design 2000, volume 27, pages 721-732

Energy[151]. This produces a profile of what remaining potential for uptake of Green Deal measures is likely to be over the period in question. This potential is then adjusted for take-up brought about by other, non-Green Deal, policies, based on projected policy savings that are derived from DECC's energy model. This is to eliminate double counting of savings. The take-up of measures under the BAU and under the central scenario of the Green Deal is indicated below After 2022, it is assumed the penetration of energy efficiency measures reverts to the BAU profile. Note that these figures do not account for take-up as a result of supporting policy within the private rented sector.

**Table 56 Energy savings from BAU policy and the additional savings from the non-domestic Green Deal.**

| Measure | Energy savings potential in 2012 (GWh) | Energy savings achieved under the BAU in 2020 (GWh) | Additional savings made under Green Deal in 2020 (GWh) |
|---|---|---|---|
| **Compressed Air** | 7 | 4 | 0 |
| **Air conditioning** | 1,250 | 1,238 | 0 |
| **Programmable Thermostats** | 16,344 | 6,832 | 277 |
| **Thermostatic Radiator Valves** | 5,458 | 2,639 | 40 |
| **Flat roof insulation** | 5,411 | 1,001 | 82 |
| **Pitched roof insulation** | 3,627 | 697 | 55 |
| **SWI** | 23 | 8 | 0 |
| **CWI** | 760 | 211 | 7 |
| **Energy-saving lighting** | 3,428 | 2,038 | 60 |
| **Lighting timers** | 9,178 | 2,678 | 231 |
| **Motors** | 6 | 2 | 0 |
| **Double Glazing** | 146 | 94 | 1 |
| **HF Ballast (Lighting)** | 379 | 243 | 4 |

## Customer Preferences for Bundle Types and the Green Deal

A decision tree is used to determine the process of moving towards a decision to take out a Green Deal. It considers the interaction between the market's participants – such as tenants and landlords – and attributes likelihoods of continuing towards a Green Deal at each major decision point they face. This gives a framework with which to model the take-up of the Green Deal when decisions are influenced at different points along this journey.

[151] Element Energy – *Uptake of Energy Efficiency in Buildings* – 2009. http://downloads.theccc.org.uk/docs/Element%20Energy_final_efficiency_buildings.pdf

Results from the Green Deal Business Survey[152] inform the attitudes of tenants and owner-occupiers to energy efficiency in general, having an in-depth assessment and obtaining a quotation for work.

A summary of the results of this modelling is shown below.

**Table 57 Results of consumer decision-making analysis during a single tenancy period (PRS) or during a 10-year period (Owner-occupier sector)**

| | % of landlords who… | % of tenants who… | % of owner-occupiers who… |
|---|---|---|---|
| **Have an assessment** | **13.7%** | **9.1%** | **12.6%** |
| **Obtain quotations for work** | 10.7% | 3.2% | 8.8% |
| **Undertake energy-management** | 22.8% | 23.0% | 28.5% |
| **Don't abate** | 79.1% | 85.0% | 52.6% |
| **Self-finance their abatement** | 17.5% | 8.7% | 43.5% |
| **Refer to their tenant/landlord** | 0.5% | 4.9% | N/A |
| **Take out a Green Deal** | **2.8%** | **1.3%** | **4.0%** |
| **Green-Deal-triggered (self-financed)** | **1.2%** | **0.5%** | **2.3%** |
| **Total Green Deal stimulus** | **4.1%** | **1.8%** | **6.2%** |

### Producer cost-benefit analysis

Step 3 allows for a profile of Green Deal-driven installations to be produced, from which costs and benefits may be analysed. These follow Green Book guidance and include time-series valuations of carbon, energy, air quality, the costs of undertaking successful and unsuccessful assessments, the costs of finance, and hidden costs. Hidden costs are assumed to be an additional 20% of the capital costs for Green Deal measures, and are factored in to the costs to the consumers. It is assumed that these are not visible at the time of decision-making, and do not affect the rate of take-up of Green Deals. It is assumed that there are two assessments completed for every one successful Green Deal in the voluntary sector. The costs of these are assumed to be paid by the business having the assessment.

## Non-Domestic Private Rented Sector Regulation Model

The impact of a supporting policy targeted at the PRS sector is modelled separately from the voluntary take-up of the Green Deal (see Annex B for details on the PRS regulation policy). This is because of three main factors:

[152] A report on the Green Deal Business Survey can be found on the DECC website http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx

- this policy is likely to require landlords to install energy-efficiency measures that meet the Golden Rule;
- this policy would affect a subset of the total stock of premises that can qualify for the Green Deal; and
- the mix of measures is likely to be different from those who voluntarily utilise the Green Deal, where there is no requirement to link the measures and a premises' EPC rating.

A working assumption to model this policy has been to apply it to all new tenancies taken out in premises with an EPC rating of F or G, the least energy efficient bands. It is further assumed that it would require these premises to undertake all the energy efficiency improvement measures compliant with the Golden Rule, which would improve their rating to E or better. Due to the strictness of the Golden Rule criterion, some buildings' physical constraints and the rate of turnover of leases, the model suggests that not all rented premises would achieve an E rating if this policy was fully bedded into the market.

The stages undertaken to estimate the figures are as follows:

### Identifying Total Abatement to Move Band F&G-Rated Boilers to band E

This is based on analysis undertaken by the Carbon Trust[153] , which identifies the average costs and savings that would be required and delivered for a typical building to move up from a specified EPC rating to another. Adjustments are made so that this analysis is consistent with The Green Book's[154] appraisal guidelines. Further adjustments are made to model just those buildings in bands G and F, and determine how much abatement they would require to move to band E.

### Reduce to the Scope of PRS-Focused Supporting Policy

Several factors limit the deliverability of the energy efficiency opportunities initially identified. Achievement of the Golden Rule once finance has been taken into account; exemptions for listed buildings; the inability to get to an E EPC-rating with Green Deal-compliant measures; and other individual circumstances are each likely to affect the impact of such a policy. To account for these constraints, an 'undeliverability' factor has been applied (35%, 25%, and 15%) of the identified abatement potential for the Low, Central and High take-up scenarios respectively), and a consideration of the distribution of the cost-effectiveness of measures has been made.

The rate of non-compliance with any such potential regulation is likely to be higher in the non-domestic sector relative to the domestic sector. The primary reason for this is that there is greater uncertainty regarding future energy savings within a particular property. Successive tenants are often likely to engage in different activities within the building. As a result of this, the cost effectiveness of measures and the energy savings they will achieve are much less certain. This is in contrast to most properties in the domestic sector, where use of the property is likely to be more stable.

[153] *Building the Future, Today*
http://www.carbontrust.co.uk/Publications/pages/publicationdetail.aspx?id=CTC766

[154] The Green Book, HM Treasury http://www.hm-treasury.gov.uk/data_greenbook_index.htm

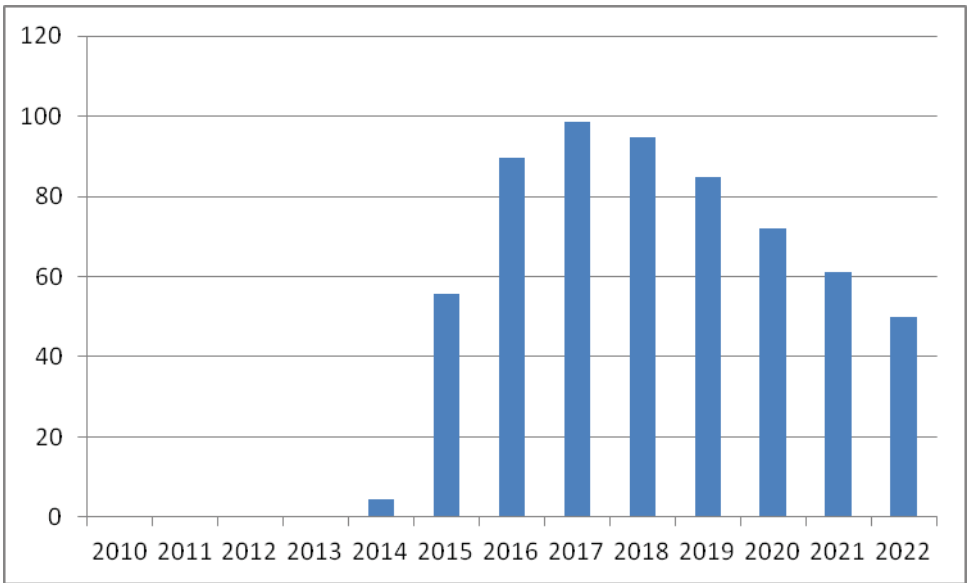
### Account for BAU Uptake & Existing policy Coverage

N-DEEM and the analysis for the voluntary Green Deal take-up are used to assess the level of take-up of relevant measures being driven by existing policy or in the BAU. This is to avoid double counting and excess attribution to the regulation.

### Fit PRS-Focused Supporting Policy Savings to Annual Profile

The aggregate savings derived from the supporting policy are applied to an annual profile of take-up, demonstrated for the central scenario in the chart below. This is dependent on the year of introduction of the policy, and also the average period of a lease. There is also expected to be some pre-compliance with the anticipated policy, as landlords anticipate its introduction.

Figure 38 Annual energy efficiency capital installations as a result of regulating the non-domestic rental sector (£m)




### Producer Cost-Benefit Analysis

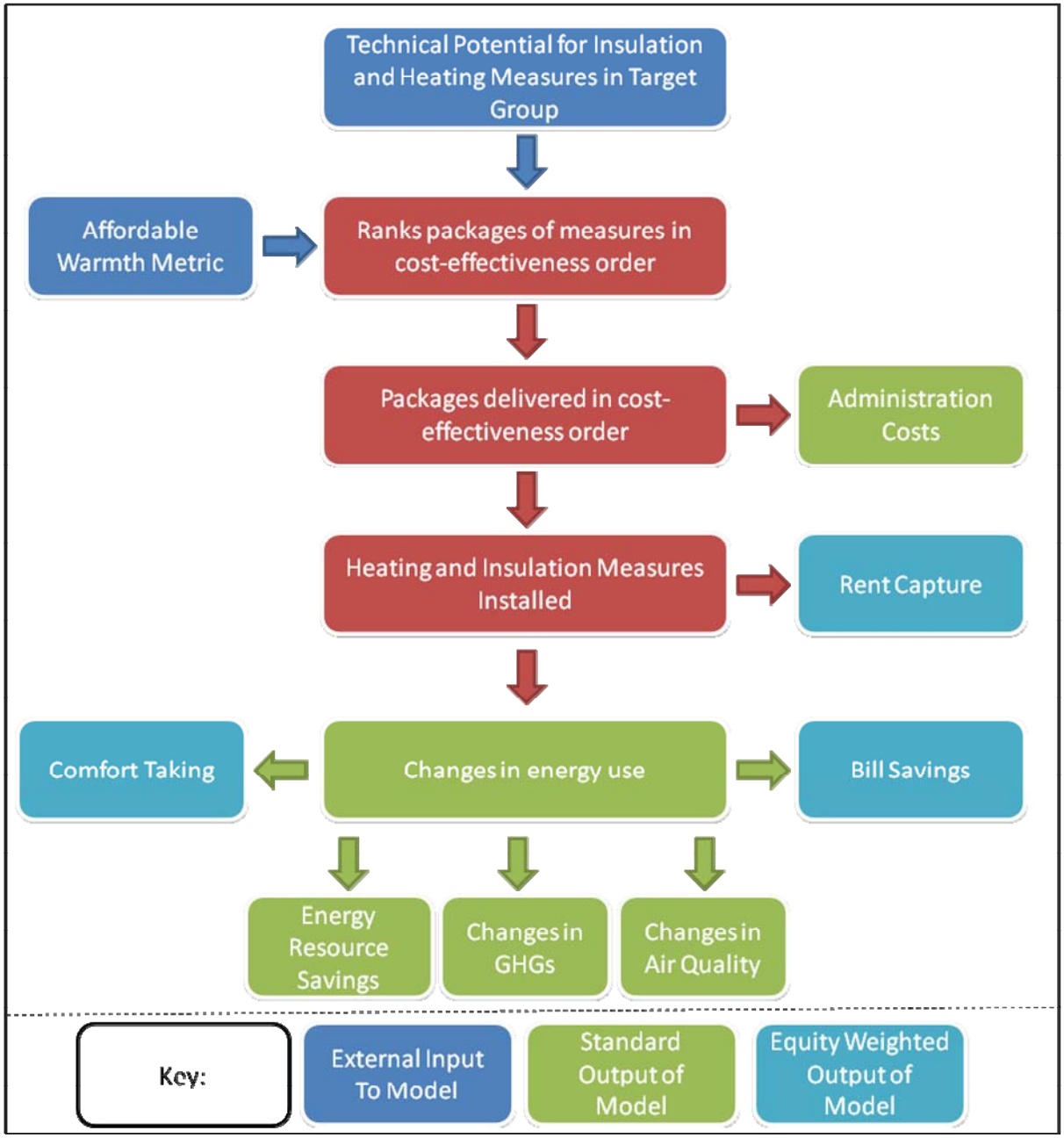
The annual profile of installation of measures allows a time-series of the relevant components to be created, from which net present costs and benefits are calculated.

# Annex D: The Affordable Warmth Model

## Summary of Overall Approach

The Affordable Warmth model simulates the delivery of measures that reduce the cost of heating homes for low income and vulnerable households. A summary of the modelling methodology applied in this Impact Assessment is shown below and set out in detail in this section. A summary of the changes in approach and input assumptions is also detailed below.

Figure 39 Summary of methodology for the Affordable Warmth Model (AWM)




The model firstly assesses the technical potential for installing a range of major insulation and heating measures in a specified target group of households, based on combined data from the English Housing Survey, Scottish House Condition Survey and the Living in Wales Survey. It then

estimates how each package of measures would score against the Affordable Warmth Metric (notional reductions in heating costs), and compares this to the cost of installing each package. This allows the cost-effectiveness of each package of measures to be compared on the basis of the cost per Affordable Warmth point achieved by the package. Packages are then ranked on this basis, based on the assumption that participating suppliers will seek to achieve the Affordable Warmth target at minimum cost.

The model then simulates the installation of packages of measures, in cost-effectiveness order, until the target has been met. This results in a number of heating and insulation measures being installed and the generation of some economic surplus. The measures installed lead to changes in energy consumption in the domestic sector, where households receiving measures reduce their overall energy consumption if insulation is installed, and typically change the type of energy they consume where a heating measure is installed. As both types of measures typically reduce the cost of heating, households may choose to take some the savings in costs as comfort by increasing the temperature they heat to (we term this 'comfort taking'). The overall changes in energy use result in energy bill savings, as well as reductions in energy use, greenhouse gas emissions and air quality.

### *Changes in Affordable Warmth Modelling Since the Consultation Impact Assessment*

The Affordable Warmth modelling for this impact assessment includes changes to a small number of input assumptions (consistent with updates to the Green Deal Household Model outlined in Annex A), a change in modelling approach from delivery of single measures to packages of measures, and changes in final policy decisions.

### *Updated Input Assumptions*

Changes to the input assumptions for the Affordable Warmth (AW) modelling include:

- Consistent with the Green Deal Household Model, an update has been applied to the share of technical potential to deliver cavity wall insulation that is 'easy-to-treat' and that is 'hard-to-treat'. The estimated number of easy-to-treat cavity walls compared to hard-to-treat is now higher, which results in a higher number of more cost-effective opportunities. This will mean that under the AW target the number of measures that can be delivered will increase, the total reduction in notional heating costs that can be achieved will increase, and the overall Net Present Value (NPV) of achieving the target will increase.

- The consultation stage Impact Assessment analysis had assumed that new and replacement heating systems would score against the AW target in terms of the reduction in *space heating costs only*. In line with final decisions around the methodology for scoring the AW target, we have increased the estimated notional savings from new and replacement heating systems as they will also affect the notional costs of water heating. This will slightly increase the relative cost-effectiveness of heating measures relative to insulation in meeting the AW target, and increase the scale of the AW target.

- Since the consultation Impact Assessment the anticipated costs of heating measures has been updated with the latest available data on the physical costs of installing new and replacement heating systems, based on past and current Government sponsored energy efficiency schemes.

These updated costs are typically lower than those used in the consultation Impact Assessment analysis. This results in the projected delivery of more measures under the AW target and will increase the NPV of achieving the target.

### *Updated Approach to Modelling Delivery of Measures*

There has been one significant change to the overall modelling approach for AW measures. In the consultation Impact Assessment each measure was considered in isolation, and measures were delivered in cost-effectiveness order. This meant the most cost-effective measures were delivered first, and when the feasible potential for delivering that measure was exhausted, suppliers were assumed to move on to delivering the next most cost-effective measure.

The new approach taken reflects a delivery model more consistent with stakeholder views and observations from current and previous Government sponsored energy efficiency schemes. This approach identifies whether multiple opportunities to install measures in a single home exist (e.g. a home where a new heating system could be installed along with cavity wall insulation), and if so measures are packaged together (e.g. previously a new heating system and a cavity wall insulation installation would be treated separately, whereas we now package them together as 'heating system plus cavity wall insulation').[155] The most cost effective packages are then delivered first, with more expensive packages (e.g. solid wall insulation) only delivered if more cost-effective packages have been exhausted. This packages approach will slightly reduce the cost-effectiveness of the modelled mix of measure delivered, and therefore reduces the NPV of achieving the AW target.

### *Updates to reflect final policy decisions*

The two main policy decisions that have had an impact on the AW modelling relate to:

- Eligibility. The preferred option in the consultation Impact Assessment in relation to proposed eligibility criteria for AW support was to combine the set of passport benefits that make up eligibility for the current CERT Super Priority Group (for private tenure households). The consultation also sought views on the possibility of extending this preferred option to include Working Tax Credit and potentially widening the age restrictions currently applied to the CERT Super Priority Group, and the Government is implementing this extension to the eligible group proposed in the consultation. This increases the size of the eligible group and therefore increases the scope for the delivery of cost-effective measures that score against the AW target. This results in an increase in the number of measures that can be delivered under the target and also increases the NPV.
- Allocating the ECO. The consultation requested views on whether the ECO should be allocated between participating suppliers on the basis of the number of customer accounts held by each supplier, or the volume of energy supplied. The consultation Impact Assessment assumed that

[155] We cannot be sure in which specific dwellings boilers will break, and therefore in which dwellings there will be opportunities to deliver insulation in combination with a boiler replacement. We therefore apply a probability-based calculation to estimate how many broken boiler replacements can be packaged together with insulation measures. For example, if in a single year 10% of eligible households have a broken boiler, and 5% have an unfilled cavity wall, the number of households with the opportunity to package together a boiler replacement and cavity wall insulation will be 10% x 5% x Total Size of Eligible Group.

the ECO would be allocated based on customer accounts, and potentially result in a 'per customer' pass through of costs to energy bills. Following majority support for a supply-based allocation in the consultation, the Government is allocating the ECO on the basis of kWh of gas and electricity supplied, with 50% of the obligation set based on the kWh supplied of each fuel. The modelling assumes that costs of the ECO are passed on in the way that they were allocated, therefore resulting in those households in lower income groups (who on average tend to consume relatively less energy) paying a smaller share of the costs of the obligation. This is a distributional issue, so does not alter the NPV of achieving the AW target, but does increase the equity-weighted NPV.

### Technical Potential and Measure Delivery

The number of opportunities to deliver measures that result in reductions in notional heating costs in the target group is identified from the English Housing Survey, the Scottish House Condition Survey and the Living in Wales Survey. While any measure that would reduce the notional heating costs of a dwelling could be installed to meet the Affordable Warmth target, the modelling considers only the measures which generate the most significant reductions in notional energy use.[156] Over the lifetime of the ECO, the Green Deal, Carbon Saving Obligation and Carbon Saving Communities Obligation are expected to deliver a certain number of insulation measures to the Affordable Warmth eligible group. As such, the total technical potential deliverable by the Affordable Warmth obligation is reduced accordingly. Consistent with the Green Deal Household Model, adjustments are made to the technical potential to account for activity under the Carbon Emission Reduction Target (CERT) and Warm Front up to 2013.

A number of the technical potential measures may also not be feasible to deliver, a small number of households may be able to install measures independently, or similarly suppliers may not be able to identify all eligible households with opportunities. As such, and to account for this uncertainty, a 15 per cent reduction is applied for the technical feasibility of the measures.

Within the technical potential of measures for delivery under Affordable Warmth two broad types of measures are delivered: 1) stocks – where the potential to install measures does not change over time unless measures are installed (e.g. opportunities to install insulation); and 2) flows – where over time more opportunities become available (e.g. heating systems breaking over time).

- The technical potential *stocks* are reduced each year as Affordable Warmth installs insulation and new heating systems to households that previously had no heating system.
- As boilers break, this adds to the technical potential in the target group and as such comprises a *flow* of opportunities. The average lifetime of a boiler is twelve years. For the purposes of estimating the flow of broken boilers which need to be replaced, the model uses the *conservative* assumption that of the stock of boilers in the eligible group 1 in 14 will break each year.

We use the information on technical potential to build a supply curve for AW compliance. In theory, the lowest cost way of meeting a given target would be for suppliers to work their way up the supply

[156] Defined here as cavity wall insulation, loft insulation, new central heating systems, replacement heating systems, and solid wall insulation.

curve – i.e., delivering all of the lowest cost insulation measures before moving on to the next most cost-effective measure. However, in reality we would expect that where possible suppliers will want to deliver packages of measures whilst they have access to a property. As such the model assumes that measures are delivered as packages.

The model ranks all possible package combinations in cost effective order, with the package achieving an Affordable Warmth point (which will be defined in terms of reduction in notional space and water heating costs) at the lowest cost being delivered first. As such, the model predicts that some more expensive measures are installed where they are packaged in tandem with cheaper complementary measures.[157] The supply curve is recalculated each year as measures are installed, therefore reducing the stock of opportunities, and the flow of technical potential in the eligible group changes.

### Supplier and Customer Costs

Costs borne by the *supplier* are modelled in two parts; the cost of delivering the measures and the costs of administering the scheme.

- *Delivery costs* comprise of the initial household survey, material and labour to install the measure, and a follow up inspection. Costs for the survey and follow up inspection are assumed to be similar to that of other government backed schemes of comparable scope and scale. Direct costs of installing each measure (labour and material) are consistent with the Green Deal Housing Model (and call for evidence that informs its assumptions) and modelling of other government schemes as appropriate.
- *Administration costs* to the supplier are separated into two parts; fixed and variable (see section on 'One In, One Out' for more detail on calculations of administration costs).
    - The *fixed costs* account for the cost of setting up and running the scheme, these include an assumed cost of personnel resource estimated at appropriate FTE values.
    - The *variable costs* include an additional cost per measure installed; The model assumes that households receiving measures through the scheme will require at least one phone call to an energy supplier and 30% of the measures will require a follow up call.

The *customer* will also face direct costs associated with the installation of any measure, such as redecoration, loft clearance and time spent supervising the work. These costs are described as hidden costs and adapted from the ECOFYS report of domestic energy[158]. These are equity weighted (where appropriate) to represent the higher relative costs that households in the lower income groups face .

### Costs to Energy Consumers

It is expected that the suppliers will pass on the costs of ECO Affordable Warmth to consumers on the same basis on which it is levied. The decision has been taken to allocate the ECO on the basis of

[157] For example, a package of new central heating combined with hard-to-treat cavity wall insulation will be more cost-effective than hard-to-treat insulation on its own.

[158] ECOFYS (2009). *The Hidden Costs and Benefits of Domestic Energy Efficiency and Carbon Saving measures*. Available at: http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/saving_energy/analysis/120100111103046_e_@@_ecofyshiddencostandbenefitsdefrafinaldec2009.pdf

units (kWh) of energy supplied, with half of the obligation allocated on units of electricity supplied and the other half on units of gas supplied (see Annex H for more detail). As such, the costs of the policy are assumed to be distributed as a fixed addition to the price per unit of metered fuel (electricity and/or gas) consumed by a household, therefore higher energy consumers – which typically tend to be relatively wealthier households – paying a greater share of the costs than low energy users – which typically tend to be lower income households.[159]

### Affordable Warmth Public and Private Benefits

There are a number of benefits from the installation of energy efficiency measures. These include; comfort taking, savings on energy bills (and their wider social value), changes in greenhouse gas emissions, air quality and demand for energy.

*Comfort taking*, reflects the increase in temperature in households where measures are installed. Where measures installed reduce the cost of heating to a certain temperature level, households may choose to use some of this saving to increase warmth levels in their home.[160] This additional warmth, while lowering the reduction in energy costs experienced by the household, has a benefit in terms of additional comfort. The positive welfare impact of the increased temperatures (and therefore energy usage) is valued using retail energy prices from the Interdepartmental Analyst Group (IAG) guidance on valuing energy and greenhouse gas emissions.[161] The Warm Front Study Group report (Green and Gilbertson, 2008) showed a significant behavioural effect of the installation of energy efficiency measures in terms of increased internal temperatures in the home. This reduces the energy consumption benefits (such as reduced GHG emissions) from the measures, but also has a social and private value in itself. Heating and insulation measures are treated differently to ensure the figures align as best as possible with observed behaviour. Comfort taking in relation to insulation measures is 15% of the full saving, consistent with the evidence underpinning the Green Deal Household Model assumptions. The comfort taking that results from heating measures takes the difference in kWh usage between that used to heat the home to 18$^{o}$C before measures and 19$^{o}$C afterwards and values that difference using the retail prices for the appropriate fuel. This is based on the findings of the Warm Front Study Group report, which found that on average low income and vulnerable households tended to heat their living rooms to 17.9°C before heating and insulation measures were installed and 19.6°C afterwards.[162] To recognise the social value of the increased temperatures experienced by lower income households, we apply equity-weights to the comfort taking values when considering equity-weighted Net Present Value calculations (see Equity Weighting section for more detail).

*Energy savings* resulting from the installation of energy efficiency measures provide a society benefit in terms of a reduction in the demand for metered fuels and power generation. In line with the IAG guidance, this benefit is valued at the variable price for each unit of energy saved.

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[159] See White, Roberts and Preston (2010). *Understanding 'High Use, Low Income' Energy Consumers*. Available at: http://www.cse.org.uk/downloads/file/understanding_high_use_low_income_energy_consumers.pdf

[160] For evidence of comfort taking in previous Government energy efficiency schemes see Green and Gilbertson (2008). *Warm Front Better Health*, available at: http://www.apho.org.uk/resource/view.aspx?RID=53281

[161] Available at: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/iag_guidance/iag_guidance.aspx

[162] Green and Gilbertson (2008, p. 9). Available at: http://www.apho.org.uk/resource/view.aspx?RID=53281

Changes in demand for energy as a result of the ECO Affordable Warmth mechanism changes the amount of *greenhouse gas emissions* from the domestic energy sector. This is a significant public benefit and therefore captured by the Affordable Warmth model. IAG GHG emission factors for each fuel type are applied to the aggregate kWh changes in the consumption of the fuels. The model differentiates, for valuation purposes, between traded and non-traded greenhouse gas emissions. The changes in emissions from electricity are valued at the EU ETS price for traded carbon and from all other fuels at the DECC non-traded carbon price.

Changes in *air quality* are caused by changes in energy demand (and therefore burning of metered fuels or power generation). Air quality changes are valued using the air quality damage factors relevant for each emission source from the IAG guidance.

The installation of energy efficiency measures result in an *energy bill saving* over the lifetime of the measure. The level of bill saving will vary depending on household type and characteristics which is getting the measure(s). It will also depend on the lifetime of the measures, see below. This saving is a private benefit, in terms of the monetary saving to the household, which does not in itself have a social value therefore we do not capture it. There is, however, a social value attached to reductions in energy bills for low income and vulnerable households, which we do capture when considering equity-weighted Net Present Value calculations. We capture the social value of these savings by taking the difference between equity-weighted and unweighted bill savings (i.e. social value = [equity-weighted bill savings] – [unweighted bill savings]).

### Measure Lifetimes

Benefits vary between each measure and package installed based on both the effectiveness of the measure and the expected lifetime of the measure. The table below shows the assumed lifetime saving used in the AW model, which are consistent with those applied in the Green Deal Household Model.

**Table 58 Summary of assumed measure lifetimes used in the Affordable Warmth Model (AWM)**

| Measure | Assumed Lifetime |
|---|---|
| Loft Insulation | 42 years |
| Cavity Wall Insulation | 42 years |
| Solid Wall Insulation | 36 years |
| Central Heating | 12 years |
| Minor Measures | 4 to 10 years |

### Economic Surplus

The delivery mechanism of the ECO Affordable Warmth is via energy suppliers. As described above, packages of measures will be delivered until the Affordable Warmth target is met. The cost of a unit of Affordable Warmth compliance will be set by the interaction of the supply and demand curve (i.e. by the marginal cost of the last unit of compliance). As such, some intra-marginal economic “rent”,

or “additional subsidy” will be generated on the lower cost units of compliance[163]. This is captured in the Affordable Warmth model. This rent could be captured by the energy supplier, the installer or the household. In the absence of any evidence, we have made the conservative assumption for the purpose of the cost to business estimates that this rent is fully captured by householders receiving the measures.

### Counterfactual Heating

In order to assess the effect of installing measures in households it is necessary to estimate what households would do in the absence of the intervention. When considering the installation of heating measures, the *counterfactual heating* assumption is that 60% of households receiving a new or replacement heating system will be using secondary electric plug in heating, and 40% will be using either secondary gas heaters or an intermittent (not fully functioning) gas boiler.[164] As such, all changes in energy use and emissions are based on the movement away from a mixture of plug in electric heating and secondary/intermittent gas heating. Insulation only benefits are calculated using the saving where the household has a functioning central heating system. Heating and insulation package benefits are calculated assuming that the saving of heating and insulation encompass the move from secondary heating to central heating first, and the additional saving from insulation once the household has a fully functioning central heating system.

### Discounting

Discounting the costs and benefits associated with the obligation is undertaken in line with *Green Book* methodology of 3.5% for the first 30 years of costs/benefits and 3% for any costs/benefits after that (e.g. loft insulation bill savings are assumed to last 42 years).

### Equity Weighting

In line with *Green Book* methodology, the Affordable Warmth Model uses equity weighting to produce an additional NPV figure that reflects the distributional outcome of the policy under consideration. The use of equity weights provides a means of the valuing the impacts of the policy on different households through accounting for the differences in value that individuals at different points in the income distribution place on a £1 loss or gain.

The weights are calculated by dividing the marginal utility of consumption of the income group by the average marginal utility of consumption of the population. The marginal utility of consumption for each income group is calculated by dividing 1 by the average income of that group. The weights used in the modelling are shown below (the average income data is based on the EHS).

[163] This is referred to as “additional subsidy” the ECO mechanism costs section of the main body of the IA. See Annex H for further explanation.
[164] This is based on actual observations from similar previous Government backed schemes.

Table 59 Equity weights used in equity-weighted NPV calculations

| Unequivalised Income Decile Group | Average Unequivalised Income (2009) | Marginal Utility of Consumption | Equity Weight |
|---|---|---|---|
| 1 | £7,257 | 0.00014 | 3.84 |
| 2 | £11,112 | 0.00009 | 2.51 |
| 3 | £13,992 | 0.00007 | 1.99 |
| 4 | £17,089 | 0.00006 | 1.63 |
| 5 | £20,718 | 0.00005 | 1.34 |
| 6 | £24,827 | 0.00004 | 1.12 |
| 7 | £29,619 | 0.00003 | 0.94 |
| 8 | £35,679 | 0.00003 | 0.78 |
| 9 | £44,438 | 0.00002 | 0.63 |
| 10 | £73,770 | 0.00001 | 0.38 |
| Average Income: | £27,851 | 4.00E-05 | |

# Annex E: Estimating Employment Impacts

This section estimates the gross number of jobs created or sustained as a direct consequence of the policy package. It makes no attempt to calculate the net employment impact. As such, increases in the number of people employed in the insulation sector do not necessarily reflect increase in employment with in the economy as a whole as workers will move between sectors. Also, the numbers do not take account of substitution within the labour market. Our estimates suggests that between 38-60,000 jobs would be supported by the uptake of the measures expected by this policy, broken down as follows.

## Number of Installers

The estimate of the number of installers required is based on the number of measures installed each year. These are multiplied by the assumed productivity for each installation (man days to complete a job) set out in the Aggregate Impacts section of the main text. These estimates of productivity are based on discussions with the industry. It is assumed that an installer works 220 days a year and a full time equivalent (FTE) installer is making installations 80% of the time. In 2015, the estimated total number of installers required to deliver the number of installations is 9,800, up from around 4,700 In 2007/8.

## Number of Supply Chain Jobs

Two estimates of the number of supply chain job were made. The first is based on a 2009 Innovas report[165] which details the current number of jobs in different low carbon business sectors. This report estimated that the ratio between installer numbers and supply chain jobs (manufacturing, supply, distribution, development) was 1 : 4.75 (i.e. there was 4.75 jobs in the supply chain for each installer job creates). This ratio was used to provide the upper estimate of 46,000 supply chain jobs that would be supported by the policy. There are a number of reasons why this may be an over estimate. For example, an increase in number of installers in the sector may not lead to proportional rise in the number of distributors. On the other hand the Green Deal provider will also provide employment opportunities which will increase the number of jobs supported in the sector.

The lower estimate was produced by comparing the total capital spending in the sector with the labour to capital spending ratio estimate by Construction Skills (the Sector Skills Council for construction). The ratio of job to capital spending for housing repair and maintenance is 32.6 jobs per £1m output. A total capital investment in 2015 of around £1.08bn would give a number of insulation sector jobs supported of around 35,000 (including installers, meaning supply chain jobs would be around 25,000).

## Number of Assessors

The number of assessor has been estimated using the assumption that an assessor will conduct an average of 2 assessment per day and that there will be 3 assessments for every successful Green Deal (this conversions rate is based on the assumption that the pre-assessment process screens household for suitable customers). Based on these assumption in 2015 there will be 1.2m

[165] *Low Carbon Good and Services: an industry analysis*, Innovas, 2009 http://www.bis.gov.uk/files/file50253.pdf

assessment that will provide employment for 3,500 FTE assessors.

# Annex F: Additional Analytical Results

## Domestic Sector Scenarios and Sensitivities

**Table 60 Domestic Sector sensitivities (1)**

| | Central Scenario | Low Uptake | High Uptake | High energy prices | Low energy prices | High interest rates | Low i ra |
|---|---|---|---|---|---|---|---|
| NPV (net BAU) | 8,305 | 6,252 | 8,977 | 11,891 | 4,050 | 8,339 | 8,2 |
| Carbon saving (pa at Mar 2015) | 0.38 | 0.32 | 0.38 | 0.42 | 0.29 | 0.36 | 0. |
| Carbon saving (pa in 2022) | 1.43 | 0.83 | 1.72 | 1.87 | 0.91 | 1.35 | 1. |
| | | | | | | | |
| CWI Uptake 2013 | 398,000 | 378,100 | 386,400 | 418,900 | 332,000 | 397,500 | 390 |
| 2014 | 345,800 | 291,300 | 339,500 | 358,700 | 267,200 | 341,000 | 343 |
| 2015 | 345,000 | 278,200 | 341,500 | 358,100 | 272,800 | 340,300 | 344 |
| 2016 | 296,300 | 211,900 | 315,900 | 324,000 | 208,200 | 287,500 | 297 |
| 2017 | 276,600 | 185,800 | 286,000 | 320,200 | 204,200 | 265,100 | 279 |
| 2018 | 244,200 | 163,700 | 253,900 | 295,100 | 194,200 | 238,100 | 247 |
| 2019 | 218,100 | 145,400 | 219,100 | 261,100 | 188,300 | 213,000 | 222 |
| 2020 | 205,700 | 123,600 | 209,500 | 243,700 | 167,700 | 200,300 | 210 |
| 2021 | 193,200 | 108,300 | 204,000 | 229,200 | 160,400 | 187,100 | 197 |
| 2022 | 178,900 | 101,100 | 188,900 | 217,900 | 159,100 | 173,400 | 186 |
| Total | **2,701,800** | **1,987,300** | **2,744,800** | **3,026,700** | **2,154,100** | **2,643,300** | **2,72** |
| | | | | | | | |
| SWI Uptake 2013 | 41,800 | 48,300 | 50,400 | 36,300 | 60,600 | 32,800 | 43, |
| 2014 | 79,200 | 82,700 | 92,000 | 73,500 | 108,400 | 72,900 | 84, |
| 2015 | 102,400 | 112,300 | 114,300 | 100,500 | 136,500 | 100,500 | 107 |
| 2016 | 105,100 | 80,400 | 133,400 | 108,500 | 80,600 | 95,200 | 110 |
| 2017 | 106,800 | 89,000 | 138,900 | 124,300 | 88,900 | 99,600 | 115 |
| 2018 | 101,800 | 79,200 | 138,400 | 118,000 | 77,400 | 95,300 | 109 |
| 2019 | 91,500 | 69,800 | 122,800 | 114,500 | 65,700 | 83,800 | 98, |
| 2020 | 99,100 | 90,800 | 139,100 | 115,600 | 80,700 | 92,600 | 99, |
| 2021 | 105,000 | 95,800 | 146,900 | 135,800 | 83,800 | 102,300 | 109 |
| 2022 | 124,400 | 101,800 | 163,700 | 146,200 | 91,300 | 112,200 | 122 |
| Total | **957,000** | **850,200** | **1,239,900** | **1,073,100** | **874,000** | **887,200** | **999** |
| | | | | | | | |
| Loft Uptake Total | **1,636,600** | **1,262,600** | **1,708,500** | **1,810,100** | **1,395,600** | **1,600,500** | **1,64** |

**Table 61 Domestic Sector sensitivities (2)**

| | Central Scenario | High SWI energy savings | Low SWI energy savings | High assessment costs | Minimum 25% bill saving | Rising SWI DMF |
|---|---|---|---|---|---|---|
| NPV (net BAU) | 8,305 | 8,816 | 7,919 | 7,857 | 7,802 | 8,555 |
| Carbon saving (pa at Mar 2015) | 0.38 | 0.37 | 0.38 | 0.36 | 0.33 | 0.37 |
| Carbon saving (pa in 2022) | 1.43 | 1.57 | 1.31 | 1.36 | 1.11 | 1.48 |
| | | | | | | |
| CWI Uptake 2013 | 398,000 | 366,100 | 422,600 | 386,400 | 371,900 | 393,200 |
| 2014 | 345,800 | 319,300 | 369,500 | 328,700 | 318,800 | 345,600 |
| 2015 | 345,000 | 324,600 | 364,700 | 328,200 | 317,000 | 340,400 |
| 2016 | 296,300 | 289,400 | 308,100 | 283,300 | 252,400 | 294,400 |
| 2017 | 276,600 | 265,400 | 281,000 | 253,700 | 232,000 | 270,600 |
| 2018 | 244,200 | 238,000 | 245,300 | 231,600 | 211,100 | 242,000 |
| 2019 | 218,100 | 213,100 | 220,800 | 205,700 | 193,100 | 206,500 |
| 2020 | 205,700 | 207,400 | 204,900 | 202,500 | 177,200 | 199,100 |
| 2021 | 193,200 | 198,500 | 190,700 | 188,600 | 165,100 | 191,700 |
| 2022 | 178,900 | 185,900 | 190,400 | 177,000 | 158,900 | 178,600 |
| Total | **2,701,800** | **2,607,700** | **2,798,100** | **2,585,600** | **2,397,600** | **2,662,100** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SWI Uptake 2013 | 41,800 | 47,500 | 35,000 | 42,000 | 46,300 | 40,700 |
| | 2014 | 79,200 | 84,900 | 74,200 | 81,200 | 80,600 | 79,400 |
| | 2015 | 102,400 | 109,800 | 94,900 | 101,300 | 111,800 | 103,900 |
| | 2016 | 105,100 | 115,400 | 94,200 | 103,400 | 86,200 | 106,700 |
| | 2017 | 106,800 | 127,100 | 97,000 | 106,600 | 89,700 | 111,600 |
| | 2018 | 101,800 | 113,500 | 85,400 | 99,500 | 81,900 | 108,100 |
| | 2019 | 91,500 | 101,300 | 80,500 | 91,600 | 74,400 | 94,400 |
| | 2020 | 99,100 | 106,300 | 89,300 | 98,000 | 87,900 | 107,900 |
| | 2021 | 105,000 | 115,700 | 102,600 | 103,400 | 89,400 | 113,600 |
| | 2022 | 124,400 | 124,400 | 110,000 | 114,200 | 101,000 | 133,000 |
| | Total | **957,000** | **1,045,800** | **863,200** | **941,200** | **849,100** | **999,400** |
| | | | | | | | |
| Loft Uptake Total | | **1,636,600** | **1,600,100** | **1,660,100** | **1,538,800** | **1,472,900** | **1,633,900** |

**Table 62 Uptake of installation measures subsidised by ECO / financed through Green Deal only in the Carbon Saving Communities group, Non-Carbon Saving Communities group, and the Affordable Warmth group, by year**

| | CSC Group | | | | Non-CSC Group | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | SWI (ECO) | CWI (ECO) | CWI (GD) | Loft alone top-up (ECO) | SWI (ECO) | CWI (ECO) | CWI (GD) | Loft alone top-up (GD) | SWI (ECO) |
| **2013** | 12,001 | 77,606 | | 10,123 | 29,787 | 169,374 | 78,445 | 3,579 | - |
| **2014** | 20,036 | 83,423 | | 14,952 | 59,144 | 164,555 | 89,012 | 4,161 | - |
| **2015** | 28,136 | 81,649 | | 15,852 | 74,217 | 156,615 | 88,987 | 5,083 | - |
| **2016** | 27,974 | 69,565 | | 9,867 | 77,148 | 125,174 | 86,791 | 6,912 | - |
| **2017** | 26,729 | 68,782 | | 14,234 | 80,050 | 116,852 | 79,173 | 6,926 | - |
| **2018** | 28,047 | 61,773 | | 13,149 | 73,771 | 105,078 | 65,523 | 5,812 | - |
| **2019** | 26,504 | 55,398 | | 11,852 | 64,999 | 90,123 | 60,750 | 5,442 | - |
| **2020** | 25,122 | 51,454 | | 15,496 | 74,007 | 86,266 | 56,175 | 4,972 | - |
| **2021** | 23,395 | 47,719 | | 17,022 | 81,613 | 79,977 | 53,747 | 4,598 | - |
| **2022** | 35,685 | 43,572 | | 31,325 | 87,537 | 74,146 | 49,396 | 4,169 | 1,143 |

**Note: Loft insulation included in this table are those done independently, and do not include lofts installed alongside wall insulation.**

**Table 63 Uptake of installation measures by year**

| | SWI Internal | SWI External | CWI Easy-to-treat | CWI Hard-to-treat Unidentifiable | CWI Hard-to-treat Identifiable | LI top-up packaged with SWI | LI top-up packaged with CWI | LI a |
|---|---|---|---|---|---|---|---|---|
| **2013** | 31,342 | 10,445 | 201,054 | 4,573 | 192,351 | 9,193 | 91,133 | 5 |
| **2014** | 64,761 | 14,419 | 146,167 | 5,635 | 194,006 | 17,420 | 91,591 | 6 |
| **2015** | 82,398 | 19,955 | 145,258 | 5,817 | 193,934 | 22,518 | 86,430 | 5 |
| **2016** | 85,344 | 19,779 | 138,174 | 5,312 | 152,830 | 23,127 | 72,702 | 12 |
| **2017** | 84,950 | 21,830 | 127,125 | 5,222 | 144,259 | 23,491 | 65,706 | 14 |
| **2018** | 79,783 | 22,036 | 109,185 | 4,567 | 130,420 | 22,400 | 55,555 | 12 |

| | SWI Internal | SWI External | CWI Easy-to-treat | CWI Hard-to-treat Unidentifiable | CWI Hard-to-treat Identifiable | LI top-up packaged with SWI | LI top-up packaged with CWI | LI |
|---|---|---|---|---|---|---|---|---|
| **2019** | 70,278 | 21,225 | 100,756 | 4,216 | 113,097 | 20,131 | 48,226 | 5 |
| **2020** | 72,520 | 26,609 | 93,344 | 3,978 | 108,372 | 21,808 | 43,453 | 6 |
| **2021** | 73,192 | 31,816 | 87,015 | 4,023 | 102,204 | 23,102 | 39,035 | 5 |
| **2022** | 88,366 | 36,000 | 78,475 | 3,831 | 96,606 | 27,109 | 35,156 | 6 |
| **Total** | **732,932** | **224,114** | **1,226,554** | **47,173** | **1,428,079** | **210,299** | **628,987** | **79** |

Table 64 Uptake of installation measures by tenure, by year

| | Social Housing Sector | | | | Private Rental Sector | | | | Owner Occu | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SWI | CWI | LI top-up packaged with SWI / CWI | LI top-up alone | SWI | CWI | LI top-up packaged with SWI / CWI | LI top-up alone | SWI | CWI |
| **2013** | 25,597 | 77,833 | 16,071 | 6,466 | 9,355 | 25,471 | 10,303 | 939 | 6,835 | 222,121 |
| **2014** | 31,279 | 82,563 | 17,023 | 8,991 | 37,514 | 38,599 | 21,494 | 2,517 | 10,386 | 215,827 |
| **2015** | 36,236 | 82,150 | 17,496 | 9,180 | 51,579 | 44,236 | 26,693 | 3,260 | 14,537 | 200,865 |
| **2016** | 33,338 | 70,385 | 16,004 | 6,255 | 57,908 | 43,231 | 27,774 | 3,788 | 13,877 | 167,913 |
| **2017** | 31,111 | 71,438 | 14,833 | 8,775 | 57,307 | 42,074 | 27,304 | 4,108 | 18,362 | 151,295 |
| **2018** | 36,455 | 63,058 | 15,449 | 8,048 | 42,687 | 34,764 | 21,029 | 3,044 | 22,676 | 134,552 |
| **2019** | 34,693 | 55,468 | 14,380 | 7,081 | 32,271 | 29,032 | 16,520 | 2,459 | 24,538 | 121,772 |
| **2020** | 42,840 | 49,252 | 15,380 | 10,053 | 24,304 | 26,036 | 13,283 | 2,041 | 31,986 | 118,608 |
| **2021** | 47,461 | 45,922 | 15,517 | 11,505 | 18,532 | 23,396 | 10,878 | 1,748 | 39,016 | 112,125 |
| **2022** | 63,124 | 39,268 | 17,964 | 23,780 | 14,428 | 21,996 | 9,044 | 1,727 | 45,670 | 105,849 |

Table 65 Uptake of installation measures by group, by year

| | Affordable Warmth Eligible Group | | | | Non-Affordable Warmth Eligible | | |
|---|---|---|---|---|---|---|---|
| | SWI | CWI | LI top-up packaged with SWI / CWI | LI top-up alone | SWI | CWI | LI top-up packaged wit SWI / CWI |
| **2013** | 11,304 | 122,213 | 12,823 | 43,179 | 30,483 | 275,764 | 87,503 |
| **2014** | 17,432 | 62,893 | 15,098 | 50,201 | 61,748 | 282,916 | 93,913 |
| **2015** | 21,895 | 72,464 | 16,276 | 40,703 | 80,458 | 272,545 | 92,672 |
| **2016** | 21,439 | 62,779 | 15,135 | 110,801 | 83,683 | 233,537 | 80,694 |
| **2017** | 20,516 | 60,018 | 14,597 | 134,359 | 86,263 | 216,588 | 74,600 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2018** | 21,911 | 54,958 | 14,073 | 111,567 | 79,907 | 189,214 | 63,883 |
| **2019** | 20,194 | 50,414 | 12,855 | 43,805 | 71,308 | 167,656 | 55,502 |
| **2020** | 22,467 | 47,152 | 12,681 | 48,749 | 76,662 | 158,542 | 52,581 |
| **2021** | 23,428 | 45,439 | 12,245 | 39,423 | 81,581 | 147,803 | 49,892 |
| **2022** | 32,516 | 42,055 | 13,278 | 49,586 | 91,850 | 136,857 | 48,986 |

## Non-Domestic Sector Scenarios and Sensitivities

The sensitivities presented in these tables concern the real interest rate charged on Green Deal Finance, together with variations around carbon valuations and energy price projections. In addition, there is an analysis of the sensitivity regarding assumptions of take-up probabilities for the Green Deal, and also around the proportion of the potential savings that are undeliverable in the PRS.

The tables below show the non-domestic element of the estimated impacts of the Green Deal and the supporting policy in the PRS. The central scenario corresponds to the impacts presented in the Aggregate Impacts section. Specific sensitivities to the assumptions underlying the central scenario are also included.

**Table 66 Impact of the Green Deal in the non-domestic sector**

| | | LOW scenario | CENTRAL scenario | HIGH scenario |
|---|---|---|---|---|
| **Costs (£m)** | Installation costs | -£28 | -£78 | -£154 |
| | Hidden costs | -£6 | -£16 | -£178 |
| | Assessment costs | -£126 | -£126 | -£124 |
| | Finance costs | -£16 | -£26 | -£42 |
| | **Total costs (£m)** | **-£176** | **-£246** | **-£499** |
| **Benefits (£m)** | Energy savings (Variable element) | £262 | £501 | £877 |
| | Air quality benefits | £4 | £7 | £13 |
| | Lifetime non-traded carbon savings | £14 | £29 | £53 |
| | Lifetime EU Allowance savings | £15 | £24 | £38 |
| | **Total benefits (£m)** | **£294** | **£561** | **£981** |
| **Total (£m)** | **Net Present Value (£m)** | **£119** | **£315** | **£482** |

| | | | | |
|---|---|---|---|---|
| | 2020 Non-traded carbon savings (MtCO2 pa) | 0.04 | 0.08 | 0.14 |
| **Carbon savings** | 2020 Traded carbon savings ($MtCO_2$ pa) | 0.09 | 0.15 | 0.24 |
| | Life time non-traded carbon savings | 0.28 | 0.59 | 1.07 |

**Table 67 Impact of potential supporting policy in the non-domestic sector**

| | PRS | LOW scenario | CENTRAL scenario | HIGH scenario |
|---|---|---|---|---|
| **Costs (£m)** | Installation costs | -£486 | -£584 | -£676 |
| | Additional costs | -£97 | -£117 | -£135 |
| | Assessment costs | -£37 | -£45 | -£52 |
| | Finance costs | -£67 | -£106 | -£260 |
| | **Total costs (£m)** | **-£688** | **-£851** | **-£1,123** |
| **Benefits (£m)** | Energy savings (Variable element) | £784 | £954 | £1,110 |
| | Air quality benefits | £29 | £35 | £41 |
| | Lifetime non-traded carbon savings | £306 | £373 | £434 |
| | Lifetime EU Allowance savings | £161 | £196 | £229 |
| | **Total benefits (£m)** | **£1,280** | **£1,558** | **£1,814** |
| **Total (£m)** | **Net Present Value (£m)** | **£592** | **£708** | **£691** |
| **Carbon savings** | 2020 Non-traded carbon savings ($MtCO_2$ pa) | 0.69 | 0.83 | 0.97 |
| | 2020 Traded carbon savings ($MtCO_2$ pa) | 0.65 | 0.79 | 0.92 |
| | Life time non-traded carbon savings ($MtCO_2$) | 6.48 | 7.90 | 9.20 |

Table 68 Sensitivities within the non-domestic Green Deal analysis

| | | Low energy prices | High energy prices | 5% real interest rate | 12% real interest rate | Low assessment probability[166] | High assessment probability |
|---|---|---|---|---|---|---|---|
| **Costs (£m)** | Installation costs | -£94 | -£94 | -£103 | -£85 | -£48 | -£138 |
| | Additional costs | -£19 | -£19 | -£21 | -£17 | -£10 | -£28 |
| | Assessment costs | -£63 | -£63 | -£63 | -£63 | -£40 | -£124 |
| | Finance costs | -£26 | -£26 | -£17 | -£39 | -£14 | -£33 |
| | **Total costs (£m)** | **-£202** | **-£202** | **-£204** | **-£204** | **-£111** | **-£322** |
| **Benefits (£m)** | Energy savings (Variable element) | £376 | £563 | £563 | £473 | £476 | £745 |
| | Air quality benefits | £7 | £7 | £8 | £7 | £8 | £11 |
| | Lifetime non-traded carbon savings | £29 | £29 | £33 | £28 | £38 | £43 |
| | Lifetime EU Allowance savings | £24 | £24 | £25 | £23 | £33 | £36 |
| | **Total benefits (£m)** | **£436** | **£623** | **£629** | **£530** | **£555** | **£835** |
| **Total (£m)** | **Net Present Value (£m)** | **£234** | **£421** | **£425** | **£327** | **£443** | **£513** |
| **Carbon savings** | 2020 Non-traded carbon savings ($MtCO_2$ pa) | 0.08 | 0.08 | 0.08 | 0.08 | 0.03 | 0.12 |
| | 2020 Traded carbon savings ($MtCO_2$ pa) | 0.15 | 0.15 | 0.15 | 0.15 | 0.06 | 0.23 |
| | Life time non-traded carbon savings ($MtCO_2$) | 0.59 | 0.59 | 0.57 | 0.55 | 0.81 | 0.90 |

Table 69 Sensitivities within the analysis of the potential supporting policy in the non-domestic sector

| | | Low energy prices | High energy prices | 5% real interest rate | 12% real interest rate | 15% undeliverability[167] | 15% undeliverability |
|---|---|---|---|---|---|---|---|
| **Costs (£m)** | Installation costs | -£584 | -£584 | -£563 | -£564 | -£488 | -£680 |
| | Additional costs | -£117 | -£117 | -£113 | -£113 | -£98 | -£136 |
| | Assessment costs | -£45 | -£45 | -£43 | -£43 | -£37 | -£52 |
| | Finance costs | -£106 | -£106 | -£62 | -£158 | -£87 | -£124 |
| | **Total costs (£m)** | **-£851** | **-£851** | **-£781** | **-£878** | **-£710** | **-£992** |
| **Benefits (£m)** | Energy savings (Variable element) | £897 | £1,005 | £921 | £922 | £790 | £1,117 |
| | Air quality benefits | £35 | £35 | £34 | £34 | £29 | £41 |
| | Lifetime non-traded carbon savings | £373 | £373 | £360 | £361 | £309 | £437 |
| | Lifetime EU Allowance savings | £196 | £196 | £190 | £190 | £162 | £231 |
| | **Total benefits (£m)** | **£1,502** | **£1,609** | **£1,504** | **£1,506** | **£1,291** | **£1,826** |
| **Total (£m)** | Net Present Value (£m) | **£651** | **£758** | **£723** | **£628** | **£581** | **£834** |
| **Carbon savings** | 2020 Non-traded carbon savings ($MtCO_2$ pa) | 0.83 | 0.83 | 0.83 | 0.83 | 0.69 | 0.98 |
| | 2020 Traded carbon savings ($MtCO_2$ pa) | 0.79 | 0.79 | 0.79 | 0.79 | 0.65 | 0.93 |
| | Lifetime non-traded carbon savings ($MtCO_2$) | 7.9 | 7.9 | 7.9 | 7.9 | 6.5 | 9.3 |

[166] In the central scenario, the proportions of agents taking out an assessment are 13.7%, 9.1%, and 12.6% of landlords, tenants and owner-occupiers respectively. For the low probability sensitivity, these probabilities are 5%, 0.5% and 5% respectively. For the high probability sensitivity, these are 20%, 2.5%, and 20%.

[167] The undeliverability factor specifies the proportion of the potential savings that are not achievable through the potential supporting policy in the PRS. In the central scenario, this proportion is 25%.

# Annex G: Green Deal Mechanism Decisions

This annex reviews policies that have undergone material change since launch of the consultation. The following sections discuss our original position, the evidence and rationale that led to a revision of our initial policy preference, and the outcome of our review.

## Assessments

Our modelling of Green Deal take-up for the Consultation Stage Impact Assessment was based on the assumption that householders would be billed for the cost of assessments and this cost would be rolled into their funding requirement. In this way, they would not make a cash payment since the cost of the assessment would be factored into the Golden Rule calculation. Likewise, those householders who would not come forward to take up a Green Deal plan would be billed direct, so that the cost of failed assessments would not be socialised across successful assessments and in this way add to the overall cost of Green Deal delivery.

Following consultation responses and feedback from stakeholders we amended this approach – hence the sensitivity analyses listed below. Many consultation responses argued that full upfront payment from consumers in all cases is an unlikely model for delivery as it will restrict take-up among many consumers who may have been interested in the Green Deal where this cost was reduced or absent. Clearly a free assessment would mean that the overall social cost of assessments is determined by the conversion rate: the ratio of successful to unsuccessful assessments. Our estimate for this remains one in three based on available evidence[168].

However, free assessments for the consumer may be unlikely. There are several reasons for this. Firstly, research has often shown that consumers do not value a completely free assessment . Secondly, consumers might commission a Green Deal assessment without any intention to pursue a Green Deal, as a way to fulfil their EPC obligations without paying. Finally, any provider offering completely free assessments would have to roll the entire cost of failed assessments into their installation cost, making them liable to being undercut by a rival provider that did charge.

As such, we expect a range of likely market offers to be presented to the consumer, from a partial upfront payment to the model whereby the assessment cost is either partly or fully subsidised or else added to the Green Deal Plan.

The central scenario is based on the assumption that the cost of two failed assessments (2 x £112.50 = £225) is rolled into the cost of the measure with the remainder of the cost being recovered from households upfront in cases where a Green Deal is not taken up.

[168] We acknowledge that this ratio may require revision once the Green Deal market has come into being. Empirical findings that guide our assumed conversion rate include results from the Sutton pilot where the conversion rate was above 50%. A voluntary programme in Canada has reported a take-up rate of over 70%. The PAYS Pilot scheme found that some 60% of assessees decided to proceed with installing an energy efficiency measure. Whilst none of these schemes replicates the Green Deal, these conversion rates show that our assumption of a one in three rate is conservative by comparison.

There are a number of reasons for this approach. Firstly, some providers have indicated that they do intend to charge a small amount for assessments for the reasons discussed above[169]. Secondly, we would expect an efficient market to find ways of minimising this cost, in particular by identifying unsuitable properties in a considerably shorter timeframe than would be required for a full assessment that includes Green Deal financial arrangements and sign-up. Thirdly, the measure installation costs presented in annex A already reflect part of the price of failed assessments; the search costs in the EEPH Call for Evidence include costs for unsuccessful bids for business. So, while Green Deal search costs may be greater than those in the pre-Green Deal world that EEPH refers to, a portion of those costs are already likely to be covered.

Our customer insight work evaluated the impact of an assessment charge at varying levels on consumers' propensity to come forward and these findings have been used as inputs in our modelling of take-up .

## Interest Rate Repayment Structure

The Golden Rule principle helps to ensure that the annual Green Deal charge is lower than the expected fuel bill saving resulting from the installation of measures. Secondary legislation contains an option to prescribe or prohibit Green Deal finance terms to help ensure that bill savings continue to exceed repayments for the lifetime of the Green Deal plan. In order to help ensure customer confidence and therefore take-up, our consultation set out the options which provide the greatest certainty of this for the first and subsequent bill payers. This included fixed rate deals and those where the interest rate varies in line with the most appropriate component of the fuel and light index which forms part of the wider RPI index. Consultation responses did not show support for introducing interest rates on an index-linked basis. These were deemed to introduce an unnecessary layer of complexity and respondents welcomed the fact that a fixed rate Green Deal plan could be used to hedge against future energy price rises.

The overwhelming support therefore was to restrict interest rate regimes in the domestic sector to fixed rates, however there was some support for including the option that finance might be offered at fixed rates but feature a predetermined annual increase of the entire charge by 2% a year, in line with Bank of England inflation targets. This option will be a permissible basis for Green Deal charges. The motivation for deciding in favour of broadening the range of fixed interest charge structures is to enable a larger volume of installations to meet the Golden Rule. A fixed rate rising at a regular annual increment increases annual householder payments over the life of the Green Deal plan, but is likely to be matched, if not exceeded, by corresponding rising energy bill savings.

So, allowing Green Deal repayments to increase by 2% allows more measures to meet the Golden Rule meaning greater demand for measures and for Green Deal finance. It also means there is an increased risk of repayments exceeding bill savings. The following section analyses this trade-off and details how a 2% rising payment schedule is calculated in the GDHM.

[169] This would likely be rolled into the cost of the plan for successful assessments but be an up-front charge for unsuccessful assessments.

Imagine a Green Deal plan with principal of £3,000; a repayment period of 20 years and an interest rate of 7.5%. A flat repayment schedule gives a constant payment of £294.28 and means £5,885 is paid back in total (20 x £294.28). Using a rising 2% schedule, the *present value of this total should not change*.[170] Hence using this total and the fact that the payments must increase by 2%, the full payment schedule can be calculated algebraically. This is shown for comparison on the graph below:

**Figure 40 Chart showing the difference between flat and 2% rising repayments**

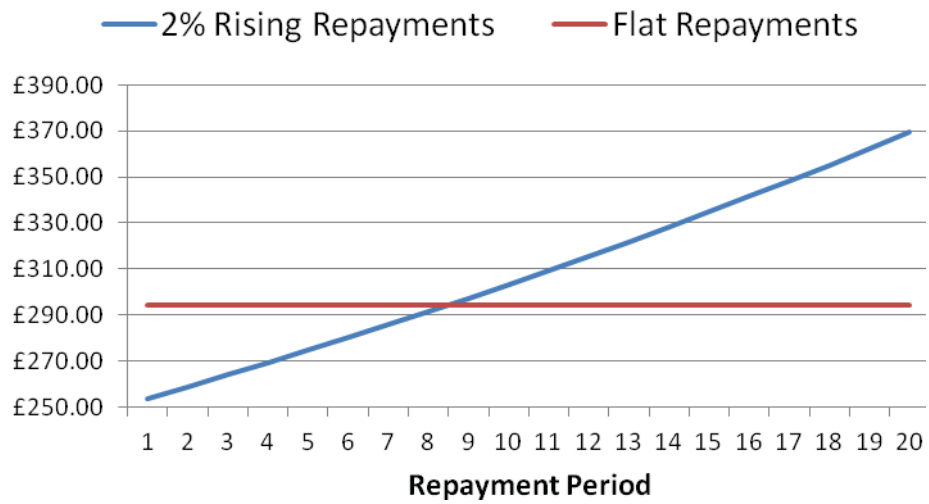



Figure 40 shows that more measures will meet the Golden Rule when charges are allowed to rise by 2%. This is because the Golden Rule is based only on the first repayment which, for any given plan, will be lower in the 2% scenario, meaning a lower bill saving is required for Golden Rule compliance.

The GDHM was used to model the demand effect of switching to a 2% rising charge. It predicts that switching from all flat repayments to all 2% rising repayments generates about 45,000 extra Green Deals in the first three years and £55m extra Green Deal finance over the same period.

To assess the increased risk of using a 2% rising charge we looked at historical retail fuel price data for 1971-2011 and projected data for 2012-2030. Situations in which repayments exceed bill savings can only arise if there are years in which energy prices rise by less than the repayments. Assuming a flat repayment structure, the data shows there are 10 such years out of 60. This only rises to 15 years under a 2% increasing repayment structure.[171]

It is also important to note that in these scenarios energy prices will be rising by less than projected inflation (assumed to be 2% based on Bank of England targets), so the fact that repayments could exceed bill savings during or immediately after these years may be offset by real savings on energy bills generally.

[170] This is because the interest rate is the same so the lender should get back the same in present value terms. But this does not mean the lender will get back the same in nominal terms. Nominally a person will pay back more when payments rise by 2%. This is because people value money today more than in the future. So a Green Deal provider will require higher overall payment if the charge rises by 2% because payments are back-weighted.

[171] We also tested this using electricity retail prices and the results were almost identical.

For these reasons the central results from this Impact Assessment use a 2% rising charge.

## Warranties

We were unable to model any costs relating to warranties in the Consultation Stage Impact Assessment as we did not have sufficient evidence available at that time to make meaningful assumptions about the cost that would be added to measures as a result. Subsequent work to understand the costs of warranties has led us to change our policy proposals in this area. An explanation of our previous and current policy is set out below. The costs of our current policy are included in the assumptions for this impact assessment.

The initial policy proposition as set out in the consultation document was that products should be warranted for the entire repayment period. This would provide maximum consumer protection and help ensure the Golden Rule continued to be met for the first and subsequent bill payers. The warranty was be required to be insurance backed and be underwritten by an A rated company.

This proposal would have been relatively easy to fulfil for inert measures such as loft, cavity and solid wall insulation but, much more costly for measures with mechanical and electrical parts (boilers, ventilation etc). The policy would create disproportionate costs for Green Deal providers which would ultimately be passed onto the customer and could create a barrier to uptake. Evidence we have gathered on indicative costs indicates this requirement almost doubled the cost of a boiler. Our customer insight work and potential Green Deal providers have indicated purchases of boilers will be a key route to market, we therefore do not want to create substantial barriers to uptake.

The requirement for insurance backed warranties also undermined some existing industry insurance schemes which could lead to unnecessary costs being incurred. There was a risk that requiring warranties to be insurance backed would require Green Deal providers to comply with a number of FSA regulations which could significantly increase costs.

In addition, The Office of Fair Trading have recently studied the cost effectiveness of extended warranties. The study indicated that most extended warranties do not currently provide value for money. They noted that it was important to ensure customers have the option and should be encouraged to shop around for warranties rather than purchase them at the point of sale. The policy proposed in the consultation, requiring Green Deal providers to offer extended warranties as part of the plan eliminated consumer choice and restricted a competitive market in this area.

Taking this into account, our revised policy is that Green Deal providers will be required to offer a minimum period of mandatory cover (five years) for warranties and an extended ten year period of building damage cover which would provide cover for any consequential building damage sustained as a result of the measures being installed. This will apply to all measures with the exception of SWI and CWI which will require 25 year cover for product warranty and consequential building cover. This exception has been made as there are cost-effective warranties already available on the market for these measures.
Green Deal Providers will be able to reduce costs by demanding extended warranties from their manufacturers and installers, but for some measures the warranty requirements may increase the

cost of the plan. Some boiler manufacturers for example, offer five year warranties as standard and therefore no additional costs will be incurred. The costs of the 10 year consequential building cover are expected to be in the range of 1% to 2.5% of the overall cost of the Green Deal package depending on the risk of the Green Deal provider and the complexity of the measures involved.

Green Deal Providers will be able to differentiate their offers and provide customers with the choice to pay for an extended warranty or maintenance contract beyond the mandated period if desired.

Although this option significantly reduces costs and burdens, reducing the guarantee period does increase the chance that people will be paying for measures which no longer work. Repayment periods for measures extending beyond the warranty period could make some potential occupiers nervous about taking on the charge when there is no guarantee the product is working. This risk can, however, be mitigated through requiring evidence that maintenance regimes have been followed, providing comfort to potential occupants that boilers and other systems are working, as happens in the normal conveyancing process. New occupants will also be able to arrange service contracts for boilers and other measures if desired. In addition, tenants are likely to be protected by landlords lease obligations to ensure boilers, other systems and the fabric of a building are intact and working correctly. We will also place adequate information regarding warranties on the EPC to ensure full disclosure.

## Insolvency Provisions

The Green Deal framework has been developed with the view that a Green Deal provider is present throughout the lifetime of the Green Deal plan and fulfils certain functions such as updating the central charge database and updating the EPC for disclosure purposes. It is also important that a Green Deal provider is present in order to allow the Secretary of State to sanction a Green Deal provider and revise a plan if appropriate (for example if the plan has been mis-sold or the plan has been disclosed incorrectly).

Our initial policy as set out in the consultation document, was to require Green Deal providers to hold a surety bond as a condition of authorisation, which would provide sufficient funds to transfer the above obligations to another authorised Green Deal provider in the event of insolvency or loss of licence. However, responses from the consultation and consultancy work commissioned have indicated this is a significant area of concern for potential Green Deal providers as it is likely to be expensive and may act as a barrier to entry for smaller firms, reducing competition in the market. Bonds were likely to cost between 1% to 4% of market share for Green Deal providers with a good credit score, rising to 10-15% for those with a weak credit score. There were also practical concerns relating to the amount Green Deal providers should insure and that a surety bond may not guarantee that another provider would be willing to take on these obligations.

Therefore Green Deal providers will not be required to have insolvency provisions in place at the time of authorisation. Instead, the Framework Regulations and the Green Deal Arrangements Agreement will ensure that, if the Green Deal Provider ceases to be authorised or is wound up, the most important ongoing obligations of the Green Deal Provider continue to be carried out by the person who is entitled to payments under the plan and customers can still, in appropriate cases, seek redress under the Green Deal legislative framework for failures of the Green Deal provider (or

its assignee). This policy will ensure customers receive an appropriate level of protection, but in a much more effective and cost-efficient way.

## Independent Conciliation Service

Our initial authorisation conditions proposed that Providers would be required to have an Independent Conciliation Service in place to offer consumers an additional option for redress. This requirement may reduce the burden on the Ombudsman services and ensure independent redress for complaints regarding Green Deal plans. However, the consultation highlighted the high cost of including this requirement as a condition of authorisation.

The Independent Conciliation Service would only ever be voluntary for the customer to use and is not essential as customers would always have recourse to the Ombudsman. In addition, this requirement could increase the time taken for customers to obtain redress. Therefore it is felt this policy would impose additional costs but provide limited benefits and has therefore been removed.

Some Green Deal providers will have access to this service as many trade bodies offer this as a benefit of membership. We will therefore recommend in guidance this service be offered to customers as an option if available.

## Green Deal Ombudsman

The consultation document set out how we would ensure redress in the Green Deal via extending the Energy Ombudsman Service's role.

The ombudsman landscape for the Green Deal needs to cover several different functions. First, there are the financial aspects, which will be covered by the existing Financial Ombudsman Service. Second, there are aspects relating to the collection of the Green Deal charge, which will be covered by the existing Energy Ombudsman Service (EOS) in its role as the Ombudsman dealing with issues around energy billing and collection. However, the Green Deal introduces new functions that require a redress service if something goes wrong.

An Ombudsman and Investigation service is needed to cover these areas, specifically investigating complaints and determining redress for customers, where these have not been resolved by Green Deal Providers. Green Deal Providers will be required to submit to the jurisdiction of the Ombudsman as part of their authorisation. It will also need to provide an investigatory and reporting role for the DECC Secretary of State to inform their decision on the use of the sanctions provided for in the framework regulations. Whilst this is not in Ombudsman function as such, we would expect it to be undertaken by the same entity providing the Ombudsman services.

However, recent legal work has identified that this would require an amendment to primary legislation that cannot be done within the timescale required for the ombudsman to be in place for the launch of the Green Deal. We are therefore instead procuring for an Ombudsman and Investigation function to fill this redress gap.

# Annex H: Energy Company Obligation decisions

This section provides details of the major policy decisions for the Energy Company Obligation (ECO) which has impacted the costs and benefits of the policy. It provides a summary of how the final design of the ECO has changed since the consultation position, and analysis which has informed the final design decisions.

## Summary of ECO Consultation Position and Final Proposal

A range of decisions around the Energy Company Obligation have been consulted on. A summary of the consultation position and final proposal for the policy is presented in the table below. Further details on the assessment underlying the final policy decisions which have impacted the costs and benefits of the ECO is presented in the following section.

**ECO policy design consultation position and final proposals**

| Issue | Consultation question | Consultation position | Final proposal |
|---|---|---|---|
| Measures eligible for support under the Carbon Saving Obligation | 11, 12, 13 | Obligation should support primarily the households who live in hard to treat homes and cannot fully fund energy efficiency improvements through Green Deal finance alone.<br><br>Solid Wall Insulation (SWI) as a key technology | SWI and Hard to Treat CWI (and heat reducing measures packaged with these) are eligible. |
| Measures eligible for support under the Affordable Warmth obligation | 14, 16 | Any measure which allows eligible householders to heat their homes more affordably, should be permitted under ECO AW.<br><br>Extra incentives should not be put in place to support the installation of air or ground source heat pumps. | No change |
| Scoring of boiler repairs for the Affordable Warmth obligation | 15 | Open question - whether, and if so how, boiler repairs should be scored as an eligible measure under the AW obligation where they were more cost-effective than installing a replacement system. | Boiler repairs will be included within the affordable warmth scoring metric, but with a number of conditions in order to prevent perverse effects. |
| Household eligibility for Affordable Warmth support | 31 | Eligibility criteria proposed to be similar to the CERT super priority group but for those in private tenure only.<br><br>Consulted on expanding the group to include Working Tax Credit under £16k income and children in full time education up to 19. | Decision to expand the eligible group to include those on certain elements of working tax credit under a household income of £15,860 and those in receipt of qualifying means tested benefits with children aged 19 years or under in full time education. |

| Issue | Consultation question | Consultation position | Final proposal |
|---|---|---|---|
| Referrals | 32 | Pursue a voluntary agreement with ECO obligated companies concerning a commitment to follow up referrals from the government-procured Energy Saving Advice Service. | No change |
| Including a Distributional Safeguard in the ECO | 33 | No distributional safeguard assumed in the consultation assessment<br><br>Open question - asked for views on whether the benefits of ECO are likely to be distributed equitably, or whether regulatory intervention would be necessary to ensure a more equitable delivery pattern. | An area based "Carbon Saving Communities" (CSC) obligation focusing on the delivery of carbon reduction measures (easy and hard to treat) to the 15% most deprived areas in Great Britain will be introduced.<br><br>Suppliers will be required to deliver at least 15% of their CSC obligation to households in rural areas (the "Rural Safeguard" target). |
| Design of, and trading on, the brokerage | 51, 52, 53, 54 | Preferred consultation option was to introduce a voluntary market-based brokerage to link ECO and Green Deal finance.<br><br>Asked whether mechanism should be voluntary, and level of ECO that should be channelled through brokerage. | Government will publish a further consultation on brokerage in Summer 2012. |
| Size of the Affordable Warmth and Carbon Saving Obligation targets | 56, 57 | 25% of the average annual £1.3bn ECO spend on Affordable Warmth, 75% on Carbon Savings Obligation | No change to Affordable Warmth, remains 25% of average annual ECO spend.<br><br>The remaining 75% carbon target spend will be split between around 80% on the Carbon Saving obligation and 20% on the Carbon Savings Communities obligation. At least 15% of the CSC obligation must be delivered to households in rural areas. . |
| Division of the ECO between energy suppliers | 58 | Two possible approaches set out in consultation for calculating market share.<br>1) Obligations proportional to market share with a straight exemption for companies with less than 250,000 customer accounts<br>2) Discounting the first 250,000 customer accounts when calculating market share.<br><br>The consultation also considered whether market share should be based on numbers of customer accounts or amount of energy sold. | Obligation set based on no obligation at 250,000 customer accounts and a full market share obligation at 500,000 accounts with a linear ramp up between.<br><br>However, customer account numbers will be translated into kWh of gas and electricity so that obligations are based on sales but gas suppliers and electricity suppliers bear an equal burden |

| Issue | Consultation question | Consultation position | Final proposal |
|---|---|---|---|
| Assessment methodology for the ECO | 59 | Scoring based on bespoke assessments of the likely savings generated in each house where measures are installed. | No change |
| Target metric for the Affordable Warmth and Carbon Saving Obligation of the ECO | 60 | Affordable Warmth obligation scored on the basis of SAP-based, lifetime energy bill reductions.<br><br>Carbon Savings obligation scored on the basis of annual carbon savings. | No change to Affordable Warmth.<br><br>Measures under the Carbon Savings Obligation and the Carbon Saving Communities will be scored on the basis of lifetime carbon savings. |

## Measures Eligible for Support Under the Carbon Targets

The section provides details of the analysis underlying the policy decision on the scope of the ECO target aimed to reduce greenhouse gas emissions. The final ECO policy position is that there will be two obligations for measures intended to reduce emissions in the domestic sector: the "Carbon Savings" obligation and the "Carbon Savings Communities" obligation.

Eligible measures under the Carbon Saving obligation (CSO) are:

- Solid Wall Insulation (SWI) and other measures that reduce heat loss from buildings delivered with SWI ; and
- Hard to treat Cavity Wall Insulation (HTT CWI) and other measures that reduce heat loss from buildings delivered with HTT CWI.

Eligible measures under the Carbon Saving Communities (CSC) obligation are:

- Full range of insulation measures, including all SWIs, CWIs and Loft Insulations (LIs).

The Carbon Saving Communities obligation is intended to deliver measures to properties in low income areas (see the next section for details). The modelling for Carbon Saving Communities allows subsidy for all CWIs and LI in properties in the 15% most deprived Lower Super Output Areas[172]. The distributional considerations of this final option are presented in the next section.

### *Consultation Proposal & Responses*

The consultation proposed that the ECO CSO should focus on more expensive energy efficiency measures in the domestic sector. It would therefore support primarily households who live in hard to treat homes and cannot fully fund energy efficiency improvements through Green Deal finance alone. The consultation proposed that SWI was a key technology for the ECO CSO to support but highlighted that there may be other hard to treat technologies which could also be eligible. The consultation also proposed that other measures would be classified as eligible under the CSO if they were promoted as part of a package that includes SWI. The modelling carried out for the consultation assumed that ECO CSO subsidy was only available for SWI and other measures packaged with it.

[172] See "Balance Between ECO Carbon and Fuel Poverty Objectives" for definition

Several consultees, including the insulation industry and the Committee on Climate Change[173], expressed concern about relying on the Green Deal market to deliver LI and CWI rather than having more certainty of delivery through including these within ECO CSO regulation. The insulation industry was concerned about a possible "cliff edge" in the delivery of insulation measures currently subsidised under existing supplier obligations (CERT and CESP), and the impact this could have on the industry. The Committee on Climate Change expressed concern that the exclusion of Lofts and Cavities from the CSO would prevent the uptake of the remaining potential of these measures and the impact this could have on carbon budgets. Potential Green Deal providers, however, have informally expressed concerns that a move to subsidisation of all LI and CWI in the carbon target could jeopardise their business model. Concerns were also raised informally by the solid wall supply chain that the inclusion of lofts and cavities in ECO would go too far in displacing the number of solid wall insulations.

### *Analysis of the Issue*

There are several potential issues with restricting the scope of the carbon target elements of ECO to primarily focus on SWI as proposed in the consultation. These include:

- **"Cliff-edge" in CWI delivery:** If CSO eligibility was restricted to SWI only, CWI delivery in 2013 could be under half the rate of CWI delivered in the last few years of CERT (see Figure 41 below). The opportunities for CWI are being exhausted so it is inevitable that the delivery rate for CWI will naturally decline. However, this option could lead to a sudden drop in delivery rather than a steady transition away from subsidising all CWIs, and could have negative impacts on the existing CWI industry.
- **Not all the remaining cost-effective CWI and LI potential beyond CERT extension would be delivered under the policy proposal:** Without ECO subsidy for lofts and cavities, consumer demand and take-up of these measures would be lower, despite the availability of Green Deal Finance and supporting policies and incentives. By 2022, 24% of the CWI technical potential would be filled by Green Deal Finance if these measures were excluded from ECO. In particular few hard to treat cavities would be filled because they will often not meet the Golden Rule without subsidy.
- **SWI supply chain constraints:** Evidence suggests that the industry's ability to deliver SWI in the first few years of the ECO would constrain the delivery of SWI below what was assumed in the consultation impact assessment. Industry's view on the potential for SWI ramp-up is reflected in this assessment (see annex A for details).
- **Uncertainty over SWI effectiveness:** Emerging evidence on SWI has resulted in significantly reduced estimated cost-effectiveness for these technologies than was assumed in the consultation (see annex A for detailed SWI assumptions).

There are several options to address the issues above in the ECO policy design. This analysis considers three options for broadening out the scope of the ECO carbon target in terms of the inclusion of LI, CWI and other measures.

[173] http://downloads.theccc.org.uk.s3.amazonaws.com/Green%20Deal/green%20deal%20letter%20-%20201211.pdf

**Option 1:** (Consultation proposal) SWI stand alone, and "other measures[174]" packaged with it. CWI and LI in the Affordable Warmth obligation only)

**Option 2:** SWI stand alone, LI and "other measures" packaged with it; and Hard-to-Treat CWI stand alone, LI and "other measures" packaged with it

**Option 3**: SWI, all CWI and LI stand alone

These three high-level options are analysed to illustrate the principal trade-offs associated with the inclusion of loft and cavities in the carbon savings target. There is a continuum of options in between the two extremes of Options 1 (consultation proposal scope) and Option 3 (full inclusion of LI and CWI). This assessment analyses one such variant (Option 2), in which the inclusion of CWI is limited to the more difficult to treat, and therefore more expensive, CWI potential.

There are further options for LI and CWI inclusion in the ECO carbon target beyond the technology eligibility criteria options above. Analysis of two such options, a differentiated scoring rule between technologies ("exchange rate" approach) and full inclusion of loft and cavities to an earmarked group of properties on an area basis ("Carbon Saving Communities"), are provided in section C below.

There are potential downsides to allowing ECO to subsidise relatively cost effective technologies like LI and low cost CWI (some of which meet the Green Deal "Golden Rule"). These downsides include:

- Subsidising of measures that would have otherwise been paid for by Green Deal Finance. The carbon savings from these measures would not be additional.
- The possibility that large amounts of ECO is spent on subsidising measures above consumers' reservation level of subsidy -"**additional subsidy**" (this is referred to in the following section as "**rent**"[175]).
- There are distributional dis-benefits where ECO subsidy crowds out Green Deal Finance. The cost of ECO will be borne by all energy consumers, whilst the cost of measures taken delivered with Green Deal will be paid for by the beneficiary. These dis-benefits are greater when funding measures which would meet the golden rule.

### *Quantitative results from option analysis*

Modelling of the three options highlights the inevitable trade-offs associated with broadening out the scope of the ECO carbon target obligation. .

[174] "other measures" could refer to all measures listed in Annex A of the Green Deal and ECO consultation document. However, for the purpose of the modelling for this analysis, only those measures that we believe could be financed as part of a package and which would provide a reasonable level of aggregate savings have been included. These include floor insulation, draught-proofing and double glazing.

[175] The term rent here is used to describe intra-marginal rents. These rents are due to heterogeneity in costs of generating ECO points across households. Intra marginal rents will be realised by non-marginal sources of abatement/ECO points, i.e. by the generation of points from households on the ECO point supply curve left of the marginal source.

The **uptake of SWI** will be lower where suppliers can deliver their obligation by subsidising lower cost measures like CWI, as suppliers have the incentive to deliver carbon savings at the lowest cost. The total uptake of insulation measures is greatest under Option 3, where uptake is predominantly CWI. However, the analysis suggests that in this scenario the uptake of SWI is significantly lower, and possibly below a level which could be needed to develop the future supply chain for this industry. SWI uptake is highest under Option 1 at 275,000 to March 2015.

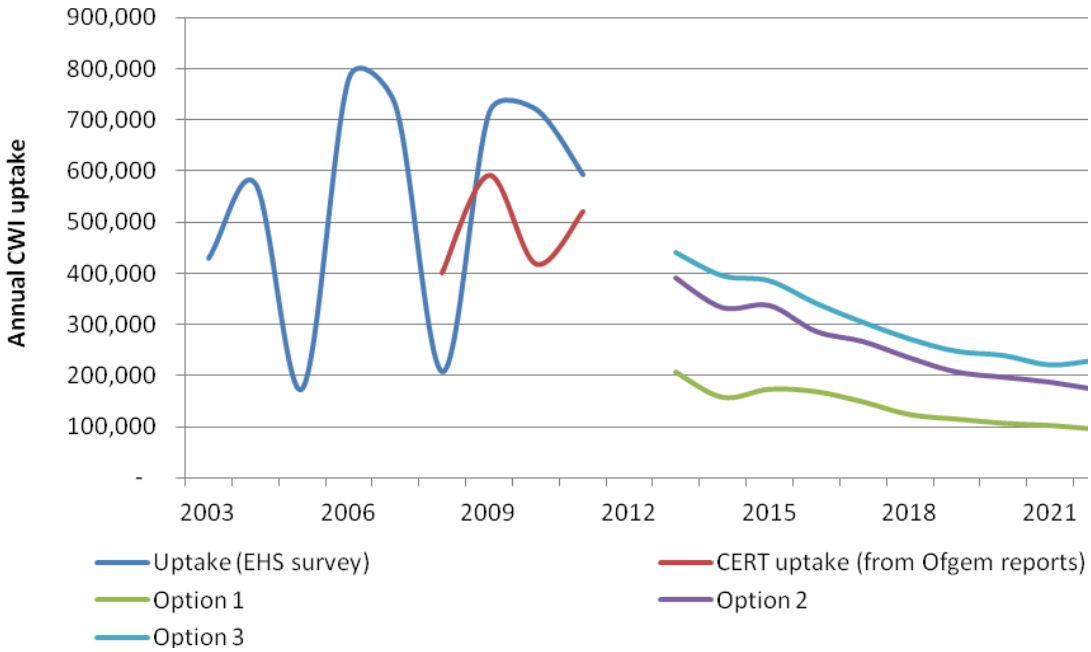
**Table 70 Cumulative uptake of CWI and SWI under Options 1, 2 and 3 to March 2015**

| | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **SWI** | 275,048 | 170,066 | 114,843 |
| **CWI (total)** | 409,669 | 808,084 | 931,442 |
| ***"Easy"*** | 344,966 | 346,839 | 579,388 |
| ***"Hard"*** | 64,704 | 461,244 | 352,054 |
| **LI** | 247,496 | 338,528 | 481,739 |

Higher delivery of insulation measures leads to higher non-traded **carbon savings.** These savings are higher p.a. in March 2015 under Options 2 and 3 (at 0.31 $MtCO_2$ and 0.36 $MtCO_2$ respectively) compared to Option 1 (0.12 $MtCO_2$) . However, although a higher carbon target for the ECO could be set with the full inclusion of all cavities and lofts, much of this increase might not be additional – they are savings that would have been delivered by Green Deal Finance alone under the other options.

A "**cliff-edge" delivery in CWI** from recent delivery rates is mitigated under Options 2 and 3 relative to the consultation proposal. CWI uptake is higher under Option 2 than Option 1 because of the inclusion of hard to treat cavities in Option 1. The uptake of "easy" to treat CWI is particularly high under Option 3. Much of the uptake of "easy" CWI under Option 3 is not additional, as around 345,000 of these cavities would have been taken up with Green Deal finance only (as under option 1 and 2).

**Figure 41 Uptake of CWI under Options 1, 2 and 3**

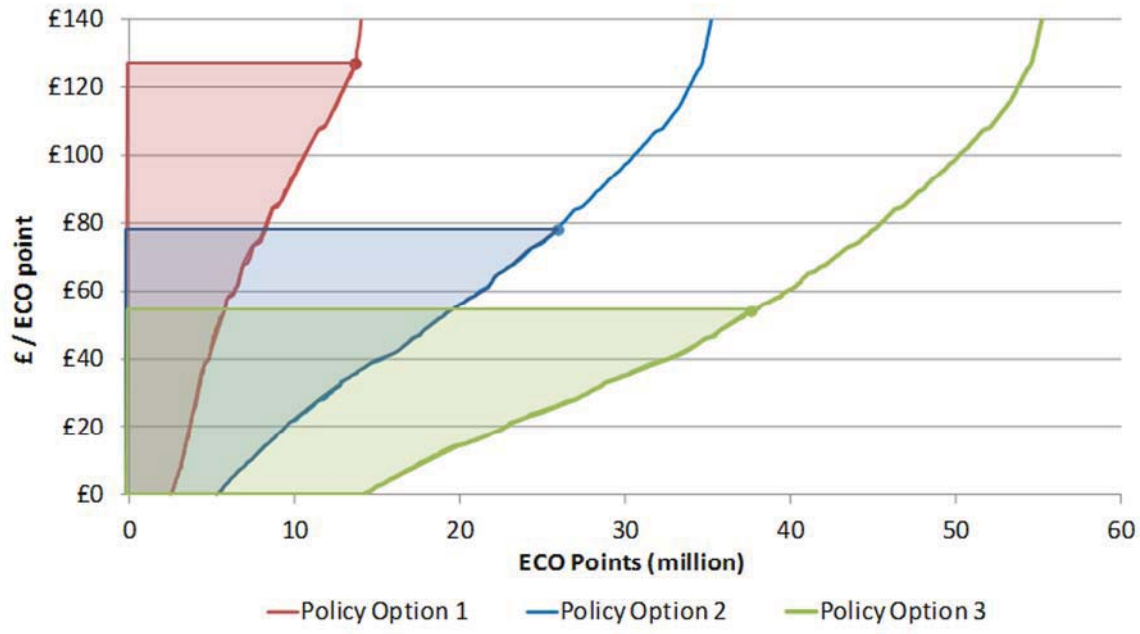



The amount of **Green Deal Finance** is greatest under Option 1 at £692m to March 2015. There is a significant negative impact on Green Deal finance under Option 3 (£178m lower ), and only a marginal decrease under Option 2 (£9m lower). Low levels of Green Deal finance such as those under Option 3 could have a knock on effect on the Green Deal market by increasing the interest rate offered. However, it is not possible to capture this effect in the modelling.

The options with the broader inclusion of lofts and cavities have a lower **marginal subsidy cost** per ECO point. Under Option 3, the marginal subsidy cost per ECO point for the period to March 2015 is £57. The marginal subsidy cost of an ECO point is significantly higher under Options 1 and 2 at £157 and £83 per ECO point respectively.

The amount of ECO spend that is **rent** is similar under Option 1 and 2 (59% and 62% respectively), and greater under Option 3 (72%). The amount of rent under each of the options to the period to March 2015 is illustrated by the shaded areas in Figure 42.

Figure 42 ECO point supply curves and rent (period to March 2015)




The ECO point supply curve shifts downwards where relatively lower cost sources of generating ECO points are introduced, as non-SWI measures have lower costs and require lower subsidy per ECO point to generate uptake. The shape of the supply curve is affected amongst other things by consumers' aversion to taking up measures and the costs of measures and Green Deal plans.

The amount of ECO points generated which would have required zero ECO subsidy is significantly higher under Option 3 (14 million ECO points) than under Options 1 and 2 (5.3 million and 2.5 million ECO points respectively) for the period to March 2015. Indeed, under Option 3, around £799m is spent subsidising measures that would have been delivered anyway without ECO carbon target subsidy over this period. This is almost double the comparable figures for Options 2 (£435 million) and 1 (£390 million).

The **Net Present Value** (NPV) of the cost and benefits of the options is greater the lower the amount of SWI uptake across the options. Therefore, the NPV of Option 3 (£9.5bn) is significantly greater than that of Option 1 (£4.5bn) and also of Option 2 (£7.7bn), as there is a large net benefit to the delivery of Cavity Wall insulation. This impact must be weighed against the other drawbacks of Option 3 discussed above (see conclusion below).

Table 71 NPV (calculated over the lifetime of the measures) of the three options

| NPV (£m) | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| SWI | -£899 | -£891 | -£881 |
| CWI | £2,721 | £5,965 | £7,799 |
| | £115 | £185 | £211 |

| | | | |
|---|---|---|---|
| Affordable Warmth, Non-Domestic, Cost of Business[176] | £2,526 | £2,479 | £2,396 |
| **Total** | **£4,463** | **£7,737** | **£9,524** |

### *Further option for inclusion of LI and CWI*

There are other dimensions to defining the ECO scope beyond the technological eligibility criteria. Options for this include, but are not restricted to, inclusion of LI and CWI for properties in particular low income areas ("Carbon Saving Communities"), differentiating the scoring of technologies in terms of ECO points through an "exchange rate", ring-fencing the delivery of hard to treat measures, and/or providing transitional support for LI and CWI (through, for example, cash incentives) . The first two options are explored below.

### *Exchange rate approach*

The preceding analysis in this annex assumes that eligible technologies in the different scopes generate "ECO points" on the same basis, so 1 $tCO_2$ reduction from the installation of an "easy" CWI generates one ECO point on the same basis as 1 $tCO_2$ reduction from a SWI. An alternative approach is to amend the scoring of ECO points, differentiating by technologies. The scoring rule could be amended such that the most cost effective measures, like LI and CWI, receive a lower score per tonne of $CO_2$.

This differentiated "scoring rule" would lower the attractiveness of suppliers to subsidise LI and CWI, which would have an impact particularly under Option 3. The high level impact of a scoring rule where CWI and LI only receives half an ECO point per 1 $tCO_2$ reduction under Option 3 is presented below.

**Table 72 Summary impacts of Option 3 with and without an exchange rate (for period to March 2015)**

| | **Option 3** | **Option 4 – exchange rate** |
|---|---|---|
| **Carbon savings p.a. in March 2015 (MtCO2)** | 0.36 | 0.37 |
| **SWI** | 114,843 | 182,923 |
| **CWI (total)** | 931,442 | 837,114 |
| ***"Easy"*** | 579,388 | 556,537 |
| ***"Hard"*** | 352,054 | 280,577 |
| **LI** | 481,739 | 454,451 |
| **Green Deal Finance (£m)** | £514 | £574 |
| **£/ECO point** | £57 | £92 |
| **Rents (£m)** | £1,531 | £1,401 |

[176] The total NPV to incorporate Affordable Warmth, Non-Domestic, and Cost of Business is assumed for simplicity to be identical to the Central Estimate value for each of these options. In reality there will be small variations from this central estimate dependent on uptake, however these variations are negligible in size.

This option could mitigate some of the negative implications of including LI and CWI in the carbon target by reducing rents and the subsidisation of measures that would have been delivered by Green Deal Finance. However, there is a risk that Government would set the exchange rate inefficiently with this approach. The result would be that the incentive structure would not lead to an "optimal" level of uptake of measures that balances the aim of reducing the cliff-edge in delivery, and excessive rents being generated.

Should Government set the rate too low (few ECO points generated per unit reduction in carbon savings from CWI and LI) there would be a limited impact on the uptake of measures relative to Option 1. Setting the rate too high (near a 1-to-1 rate) would risk large rents as under Option 3. It is not clear how the Government would be able to set an optimal rate. The exchange rate approach would therefore introduce administrative complexities to the ECO with the risk of low associated benefits.

### *"Carbon Saving Communities"*

The final ECO policy decision is for an expanded ECO technology eligibility for certain sub-groups of the population. Within the "Carbon Savings Communities" obligation, all insulation measures, including all CWI and LI are eligible. The detailed results of analysis of this option are presented in the main body of the IA. The high-level results are presented here for ease of comparison with the other options analysed in this annex.

**Table 73 Summary impacts of the "Carbon Saving Communities" option (for period to March 2015)**

| | **Option 8 Carbon Saving Communities** |
|---|---|
| **Carbon savings p.a. in March 2015 (MtCO2)** | 0.30 |
| **SWI** | 146,556 |
| **CWI (total)** | 830,038 |
| ***"Easy"*** | 383,536 |
| ***"Hard"*** | 446,502 |
| **LI** | 364,433 |
| **Green Deal Finance (£m)** | £616 |
| **£/ECO point** | £77 |
| **Rents (£m)** | £1,365 |

### *Conclusion*

There are inevitable trade-offs associated with broadening out the scope of the Carbon Saving Obligation beyond the consultation proposal. These are illustrated by comparing the headline results of the quantitative analysis of the five options:

Table 74 Headline results from comparison of options (all figures are for period to March 2015, except NPV which is calculated for measures delivered up to 2022)

| | Option 1 | Option 2 | Option 3 | Option 4 | Option 8 (chosen option) |
|---|---|---|---|---|---|
| **Domestic sector carbon Savings p.a. in March 2015($MtCO_2$)** | 0.12 | 0.31 | 0.36 | 0.37 | 0.30 |
| **SWI** | 275,048 | 170,066 | 114,843 | 182,923 | 146,556 |
| **CWI** | 409,669 | 808,084 | 931,442 | 837,114 | 830,038 |
| **LI** | 247,496 | 338,528 | 481,739 | 454,451 | 364,433 |
| **Green Deal Finance (£m)** | £692 | £683 | £514 | £574 | £616 |
| **£/ECO point** | £157 | £83 | £57 | £91 | £77 |
| **Rents (£m)** | £1,271 | £1,322 | £1,531 | £1,401 | £1,365 |
| **NPV (£m)** | £4,463 | £7,737 | £9,524 | £8,940 | £8,305 |

Continuing with a focus for ECO carbon subsidy on SWI only is projected to lead to a sharp reduction in the delivery of cavity wall insulation, and the carbon savings realised are lower than under the options considered for inclusion of LI and CWI.

At the one extreme, a full inclusion of LI and CWI (Option 3) would provide a simple continuation from CERT and lead to larger carbon savings and a higher NPV. However, there are negative consequences of this option in terms of subsidising measures that could have been delivered without subsidy and reducing the scale of the Green Deal Finance market. In addition, it is estimated that 72% of the total ECO spend would be rent under this option. The large share of ECO spend on measures that could have otherwise been delivered with Green Deal finance only under Option 3 provides a poor value for money case. This option would also lead to a slower start to the SWI industry, which would have negative impacts on the future development of the SWI supply chain – with implications for longer term cost effective carbon savings.

A partial inclusion of CWI could mitigate the "cliff-edge" effect and have a limited negative impact on the Green Deal finance market, compared to Option 3. A partial inclusion of in a separate obligation, as under the "Carbon Savings Communities" option, could provide greater certainty of outcomes than if done via an "exchange rate" mechanism. The options for partial inclusion have a less detrimental impact on the Green Deal Finance market than a full inclusion. The analysis of all the options are also sensitive to the underlying input assumptions.

## Balance Between ECO Carbon and Fuel Poverty Objectives

There is a limit on the resources that can be spent to deliver under the ECO obligations. The policy has multiple objectives leading to inevitable trade-offs between the achievement of carbon reduction and fuel poverty objectives. There are also several complicated factors contributing to the uncertainty around the need for a more progressive distribution of benefits under the ECO beyond the consultation proposal.

This section provides details of the analysis to support the decision for the ECO to consist of:

- An Affordable Warmth target aimed at reducing heating costs for low income and vulnerable households at risk of fuel poverty, accounting for approximately 25% of the scheme's resources;
- A Carbon Saving Obligation (CSO) focused on delivering SWI and hard-to-treat CWI in conjunction with the Green Deal, accounting for around 60% of the scheme's resources; and
- An area based Carbon Saving Communities obligation focusing on the delivery of carbon saving measures (including easy to treat CWI and loft insulation) to the 15% most deprived areas of Great Britain.

It is anticipated that under this proposal the total share of the scheme's resources targeted at low income and vulnerable households through the three obligations equates to over 50%.

### *Consultation Proposal & Responses*

The consultation proposal was for the anticipated resource costs of the ECO, around £1.3bn per year, to be split approximately 75:25 between the Carbon Savings Obligation (CSO) and Affordable Warmth (AW) obligation. The consultation included a question asking whether the proposed split would lead to an equitable distribution of benefits, and in light of that whether any further steps should be taken to ensure distributional equity through a distributional safeguard. The central consultation option did not include such a safeguard, but views were sought on the need for (and possible structure of) a safeguard.

There were differing views among consultees on what the split between ECO CSO and AW should be. Consumer groups, fuel poverty groups, devolved administrations and local authorities expressed concern that the proposed scale of the AW was not adequate. Many of these groups argued for a shift between CSO and spending on fuel poverty objectives. Some energy suppliers also supported this view.

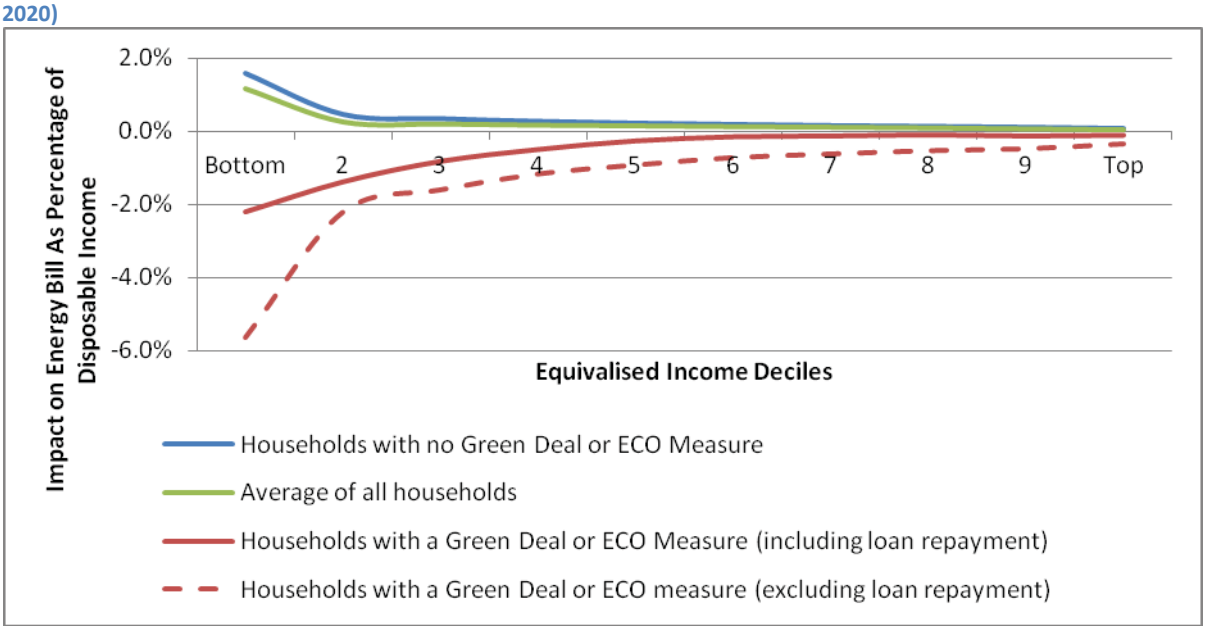
Other stakeholders, particularly Green Deal providers, raised concerns that a change to the balance would increase costs, reduce carbon savings potential and undermine delivery by the Green Deal Providers. There was also concern among providers about the overall scale of private finance in the market, identified as the most important risk to their feasibility.

### *Incidence of ECO Costs & Benefits*

Based on the analysis undertaken in the consultation Impact Assessment, it is anticipated that the costs of delivering the ECO will be recouped through energy bills, which would likely be regressive (see Figure 43 for the estimated distributional impacts from the consultation stage Impact Assessment). On average, low income households spend a greater proportion of their income on energy bills. An increase in energy bills because of the costs of the ECO will represent a greater percentage reduction in their disposable income. For those who take up a measure under the ECO, energy bills are reduced. The reduction as a percentage of disposable income is larger for low income households. However, on average the net cost of the consultation proposal for the ECO was estimated to be **regressive**, with low income groups paying more.

**Figure 43 Change in energy bill as a results of Green Deal and ECO (CONSULTATION PROPOSAL) as a percentage of income (in**

2020)




### *Distribution of the Benefits Under the ECO Consultation Proposal*

Under the consultation proposals, there was a high degree of confidence that low income and vulnerable households will benefit from measures installed under the Affordable Warmth target because measures will be delivered to a relatively small and tightly defined group. The distribution of the overall benefits will therefore depend on the share of ECO spend on AW and the distribution of installations from the Carbon Savings Target.

It is not possible to predict precisely how the take up of measures under the CSO will be distributed across income groups, and there is a significant degree of uncertainty, regarding which measures will be installed under the target will depend on a number of factors, some of which are discussed below. It should be noted that this uncertainty notwithstanding, the modelled delivery of measures under the CSO in the consultation Impact Assessment resulted in around 20% of measures being delivered to low income households.

#### Technical potential

In the absence of other factors that skew delivery, the delivery of measures under the Carbon Target should reflect the distribution of the potential for ECO points. ECO (Carbon Target) points are generated by installing measures in 'hard to treat' houses. These properties are evenly distributed across income groups. However, higher earners tend to live in larger, harder to treat properties which use more energy and have a larger scope for carbon savings. The technical potential for ECO points may therefore be skewed towards higher earners, although there are fuel poor households across the housing spectrum.

#### Cost effectiveness

Other things being equal, the more cost-effective a measure is, the **less subsidy** that will have to be offered to make it an attractive option. If cost-effective potential is unequally distributed across income groups this could skew the delivery of benefits under the Carbon Target.

**Social housing** provides natural opportunities for suppliers to deliver at scale and thus at relatively low cost. The lowest income groups represent almost half of all tenants in social housing. These tenants could benefit disproportionately from energy efficiency measures. Nevertheless, social housing tenures represent a smaller proportion of the technical potential for wall insulation than the owner occupied and privately rented properties.

The costs of solid wall insulation include an element of fixed costs and an element of variable costs. Larger properties will cost less per unit of wall area treated because of the fixed costs. Modelling suggests that **larger properties are more cost-effective** to treat as a result. Other things equal, this may encourage delivery of measures under the carbon target to higher income households.

### Regulation of the Private Rented Sector (PRS)

PRS regulation would increase demand for energy efficiency measures in this sector, and would benefit households in this type of tenure. This regulation would benefit tenants in rented properties, the majority of which are in the lowest income groups. The overall impact of this is likely to be modest, however, as benefits would be restricted to the 15% of housing that is privately rented (of which only around 20% are fuel poor).

### Willing to (part) self-finance the costs of installing measures

The higher the willingness to self-finance, the less subsidy energy suppliers will have to offer. There are a number of reasons why ability or willingness to self-finance (either through the Green Deal, or other sources of finance) may be lower for low income groups, in particular because many under-heat their homes and will achieve lower energy bill savings[177]. On the other hand, the Green Deal Finance mechanism may do more to relieve credit constraints for low income households than the wealthy.

## *Analysis of Options for Altering the Distribution of ECO Benefits*

A greater certainty of a progressive distribution of ECO benefits could be achieved by doing one or more of the following:

- altering the split in the level of ECO spend between the two obligations;
- adding a sub-obligation to one of the obligations; and/or
- changing the scope or focus of the obligations.

This section sets out five options that have been considered to provide greater certainty over the distribution of ECO benefits compared to the central consultation option.

Option 2: Consultation Proposal but with HTT CWI included in scope of ECO. Eligible measures in the ECO are SWI stand alone, hard to treat CWI, and other measures included in packages . Easy to treat

[177] The evaluation of the Warm Front scheme in 2008 showed that low income households eligible for the scheme tended to heat their homes (17.9°C) without thermal efficiency measures, whereas the last time national average indoor temperatures across all income groups was measured, the average was above 19°C (EHS 1996).

CWI and LI are included in the Affordable Warmth obligation only. The split between the AW target and CSO target is 25%/75% respectively.

**In all the other options the CSO target is used to deliver stand alone SWI *and* hard to treat CWI, and other measures packaged with it.**

Option 5: Increase the size of the Affordable Warmth target. The AW target would increase and the CSO target would reduce by a corresponding proportion so the estimated total costs of the ECO remain the same. This would guarantee a greater proportion of the ECO's resources are targeted at low income and vulnerable households, through a likely mix of heating and insulation measures. The quantitative analysis undertaken here is based on increasing the AW target to around 35% of total ECO resources, and the remaining 65% focusing on measures under the CSO.

Option 6: Include a sub-obligation within the CSO to ensure a proportion of 'hard to treat' insulation is targeted at low income homes. The AW and CSO targets would remain at the levels proposed in the consultation, with a sub-obligation on the CSO guaranteeing that 20% of measures delivered under the CSO are delivered to low income and vulnerable homes. The proxy applied to represent this group in the analysis is households claiming passport benefits that qualify them for Affordable Warmth, but extended to include social tenure.

Option 7: Expand the list of measures that could be scored under the CSO if delivered to low income households/areas. The list of measures that count under the CSO would be expanded, providing the 'additional' measures (such as easy to treat cavity wall and loft insulation) are targeted at low income communities (in line with an area based approach). The proportion of the CSO that could be met in this way would be capped (up to 20% in the analysis here) to ensure sufficient focus of the CSO on driving the Green Deal.

Option 8: Set an area based obligation ("Carbon Saving Communities") targeting carbon saving measures at low income communities. A third obligation would be set whereby participating suppliers would be required to deliver carbon savings to households living in the most deprived areas. Qualifying measures would focus on carbon reduction, and delivery would be restricted to the 15% of areas scoring most prominently on the Index of Multiple Deprivation of each GB country. As defining low income communities by geographic boundaries is not always effective at capturing rural poverty, this option contains a safeguard to ensure that rural households are not disadvantaged. Suppliers will be required to deliver 15% of their overall Carbon Saving Communities obligation to rural, low income households.[178]

The table below summaries the quantitative analysis of the 5 options:

[178] Eligibility for this option can be summarised as: households living in one of the 15% lowest scoring LSOAs in England according to the English Index of Multiple Deprivation; households living in one of the 15% lowest scoring LSOAs in Wales according to the Welsh Index of Multiple Deprivation; households living in one of the 15% lowest scoring data zones in Scotland according to the Scottish Index of Multiple Deprivation; households in an adjacent LSOA or data zone to a qualifying LSOA or data zone where measures have already been delivered to that qualifying LSOA or data zone (suppliers may deliver no more than 20% of measures to adjacent areas); households living in rural areas (settlements with less than 10,000 dwellings) and are in receipt of Affordable Warmth qualifying benefits.

Table 75: Key results of distributional equity options

| | **Option 2** Consultation proposal with HTT CWI in ECO | **Option 5** Increase AW Target | **Option 6** CSO Sub-obligation | **Option 7** CSO Sub-obligation with expanded scope | **Option 8** Carbon Saving Communities |
|---|---|---|---|---|---|
| **Carbon Savings p.a. in March 2015 ($MtCO_2$) savings p.a.** | 0.31 | 0.21 | 0.31 | 0.30 | 0.30 |
| **AW eligible group lifetime bill savings (£m)** | 7,109 | 9,100 (+28%) | 7,528 (+6%) | 7,645 (8%) | 7,430 (5%) |
| **"Easy" CWI uptake** | 346,839 | 376,012 | 344,691 | 353,991 | 383,536 |
| *of which in low income areas* | *143,658* | *172,847* | *142,643* | *151,944* | *148,773* |
| **"Hard" CWI uptake** | 461,244 | 436,421 | 458,991 | 450,868 | 446,502 |
| *of which in low income areas* | *56,888* | *52,998* | *68,184* | *54,726* | *51,381* |
| **LI uptake** | 338,528 | 360,378 | 337,475 | 340,038 | 364,433 |
| **SWI uptake** | 170,066 | 158,793 | 172,040 | 164,666 | 146,556 |
| *of which in low income areas* | *45,954* | *42,722* | *51,972* | *44,598* | *34,210* |
| **Heating systems to low income households (to March 2015)** | *276,000* | *359,000* | *279,000* | *283,000* | 279,000 |
| **Green Deal Finance (£m)** | £683 | £696 | £682 | £653 | £616 |
| **NPV (£m)** | £7,737 | £8,203 | £7,717 | £8,006 | £8,305 |

The analysis alone does not clearly identify a single preferred option. It also does not incorporate a number of key risks, such as 'cliff-edge effects' or the minimum level of Green Deal finance required for the market to function. On balance, however, Option 8 provides the best balance between guaranteeing a greater share of ECO benefits accruing to low income households, maintaining a similar level of carbon reduction ambition as in the consultation proposal, driving the Green Deal market and increasing the overall NPV of the policy.

Option 8 delivers the greatest NPV of all the options. This is driven by the greater emphasis on delivering relatively low cost easy to treat cavity wall insulation generated by the area-based target. The impact of each option on total carbon savings from Green Deal and ECO is determined by two main factors: the uptake and mix of insulation measures (which increases carbon savings) and heating measures (which typically reduce non-traded carbon savings). Uptake rates will in turn depend on the cost of driving demand and the share of the ECO focused on insulation measures. All options except Option 5 deliver similar levels of carbon savings in 2015. The lower level of non-traded carbon abatement under Option 2 is driven by the greater emphasis on heating in ECO overall through a higher Affordable Warmth target, which while delivering significant traded carbon savings, tends to reduce the overall non-traded carbon savings from the policy.

Uptake of SWI is broadly the same or lower in all options relative to Option 2. This results from either reducing the resources dedicated to SWI (Option 5), a greater level of subsidy for SWI in low

income homes (Option 6), or a greater emphasis on less expensive insulation (Options 7 and 8). Uptake of hard to treat CWI remains broadly similar across all options.

The level of Green Deal Finance remains broadly similar in Options 5 and 6, but falls in Option 7 and 8 relative to Option 2. Options 7 and 8 result in more measures being delivered to low income households, which typically require higher levels of subsidy, which reduces the scope for Green Deal Finance. However, the cost effectiveness of the greater levels of CWI in Options 7 and 8 appears to result in sufficient ECO subsidy to drive the Green Deal market such that the largest reduction in Green Deal Finance is only around 10% compared to Option 2. Option 6 requires greater levels of subsidy for relatively expensive measures in order to ensure 20% of CSO measures are delivered to low income groups, resulting in a slightly lower level of ECO resources to drive the Green Deal market for other households. Option 5 unexpectedly results in a greater level of Green Deal finance, suggesting that under Option 2 ECO subsidy crowds out the Green Deal, and this is reduced by rebalancing resources towards the AW target.

Lifetime bill savings accruing to low income households is greatest under Option 5. This is due to Option 5 delivering the greatest number of heating and insulation measures to low income groups. All other Options maintain a fairly similar overall level of lifetime bill savings relative to the consultation proposal.

## Allocation of the Obligation

The consultation sought views on how the ECO should be divided between obligated energy suppliers. This section summarises the analysis supporting the Government's decision that:

- Only energy suppliers with more than 250,000 customer accounts are required to participate in the ECO
- The obligation is divided between energy suppliers on the basis of their energy sales, with half the obligation being allocated on the basis of gas sales and half on electricity sales
- The obligation is tapered for smaller suppliers passing through the threshold, but in a way which is not expected to increase the costs associated with the ECO

### Participation in the ECO

Small suppliers with 250,000 customer accounts or less are currently exempt from having to participate in environmental and social programmes such as CERT and CESP. The rationale for this exemption is to reduce the barriers associated with entering the retail energy market, promoting competition and innovation in the market to help drive down consumer bills. The consultation responses, on balance, suggested that 250,000 customer accounts was an appropriate threshold for participation in the ECO.
It is recognised that it is in the interest of small suppliers to continue to pursue growth and some smaller suppliers have indicated that they may pass through this threshold before March 2015. As set out in the recent consultation on thresholds[179], it is not the Government's intention to continue

[179] http://www.decc.gov.uk/en/content/cms/consultations/threshold/threshold.aspx

to increase the threshold, but instead to consider ways in which future obligations, such as the ECO, can be designed to minimise any disproportionate burden faced by small suppliers when required to participate in these programmes. This is considered further in Section 4.3 below.

### Metric for Dividing the ECO Between Suppliers

In a competitive energy market, energy suppliers are expected to pass on costs in the way they are levied. This means they are expected to pass on a standing charge to each customer account if the obligation is allocated on the basis of customer accounts, and a charge per unit of energy if allocated on an energy supplied basis. There are a number of possible metrics for dividing the ECO, including:

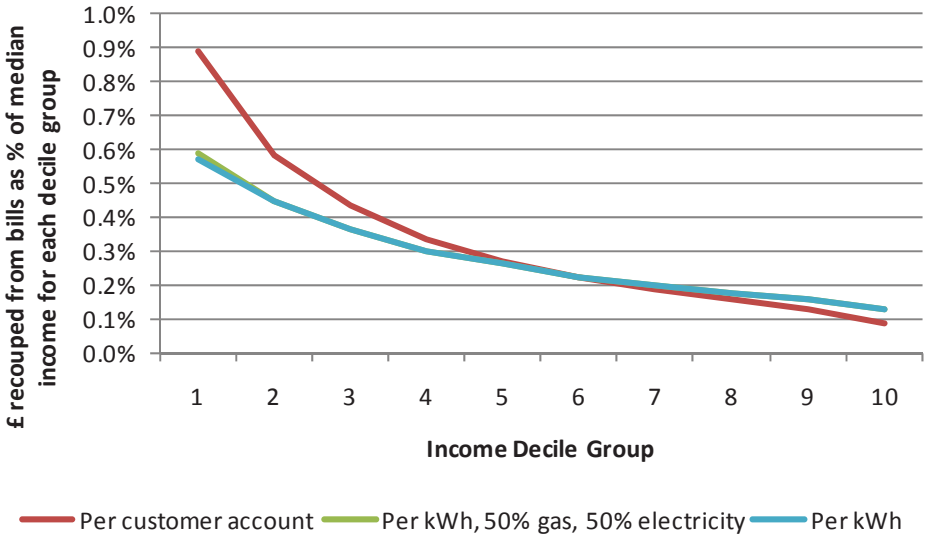
- Option 1: Dividing the ECO on the basis of the number of customer accounts
- Option 2: Dividing the ECO on the basis of kWh of energy supplied
- Option 3: Dividing the ECO on the basis of kWh of energy supplied, with half of the obligation allocated on gas supplied and half on electricity supplied

Options 2 and 3 provide a greater incentive to consumers to conserve energy than Option 1. This is because a fixed charge per customer affects the cost of connecting to energy supply, whilst an additional charge per unit of energy consumed would affect the *marginal* cost of energy use, which makes consuming *more* energy more expensive. Option 3 puts a higher marginal cost on electricity use and a lower marginal cost on gas use relative to Option 2 as the total amount of gas supplied is several times larger than the amount of electricity supplied in GB.

Option 2 and 3 would also tend to be less regressive than Option 1 in terms of the distributional impact of the cost pass through as households with higher incomes tend to use more energy. In general, low-income households would benefit from lower energy bills, although there are a number of low-income, high-usage households that would see higher energy costs under Options 2 and 3. The general impact across income groups is illustrated below. This is based on average energy consumption and income data from a CSE report to Ofgem[180].

[180] White, V., Roberts, S. and Preston, I. (2011). *Understanding 'High Use Low Income' Energy Consumers*, final report to Ofgem. See http://www.ofgem.gov.uk/Sustainability/Cp/CF/Documents1/High%20use%20low%20income%20energy%20consumers_Final%20Report%20Nov%2010.pdf

**Figure 44** Distributional impact of cost pass through across income decile groups as a percentage of median income, by approach




The impact on fuel poverty of the different options is mixed. The fuel poor tend to have the highest notional energy requirements and, as such, Options 2 and 3 (which increase the unit price of energy) will tend to increase the notional energy costs for the fuel poor by a greater extent than Option 1. Allocating the ECO on a per kWh basis is likely, therefore, to make it more difficult to remove these households from fuel poverty.

Given this assessment, the Government has chosen to divide the ECO on the basis of kWh of energy supplied, with half of the obligation allocated on gas supplied and half on electricity supplied (Option 3). This is expected to be less regressive than the historical approach of allocating supplier obligations on the basis of customer accounts, whilst not significantly altering the relative size of obligation gas and electricity suppliers face.

## Tapering the Obligation

Whilst a threshold provides a regulatory advantage by shielding small suppliers from having to meet the ECO, it introduces a possible "cliff-edge" effect. Signing up just one additional customer could take a company from having no obligation at all to having a sizeable obligation based upon their energy supply to 250,001 customers.

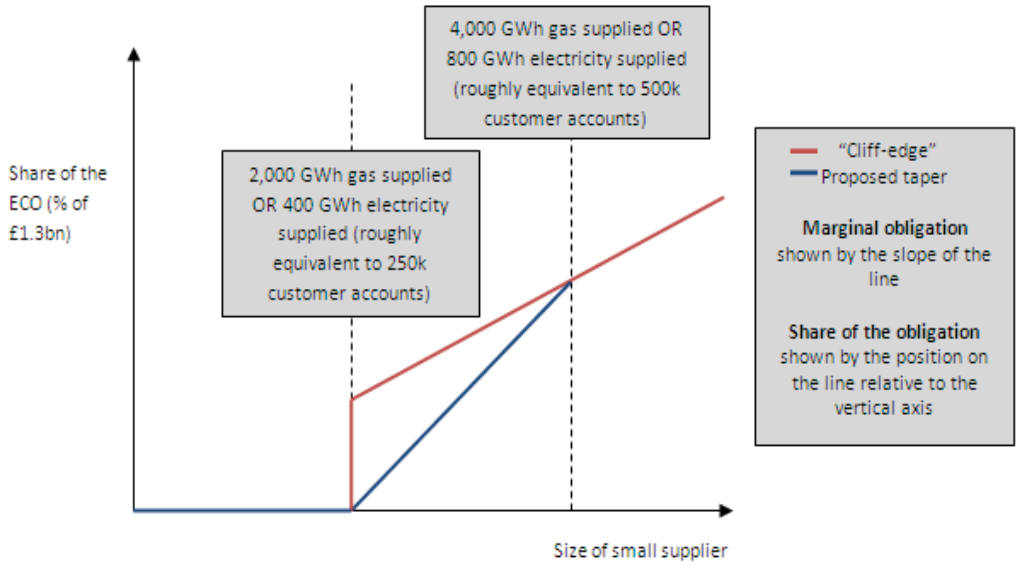
In addition to facing the high *marginal* obligation cost in the form of the carbon and bill savings they need to generate by promoting the installation of measures to meet their share of the ECO, obligated companies would also incur *fixed* costs associated with setting up systems to monitor and deliver the ECO. For a smaller supplier these *fixed* costs would be spread over fewer customers than for a large supplier. This could represent a severe disincentive to companies to take on the extra customers which would see them passing the threshold.

The consultation IA considered the option of exempting the energy supplied to the first 250,000 customer accounts of each supplier from the allocation calculation to alleviate this cliff-edge effect

for small suppliers. However, this would reduce the energy supply base over which the obligation is calculated and, in turn, increase the marginal obligation cost for all obligated companies. This would lead to higher costs being passed onto consumer bills (around 4% higher per customer account).

Therefore, the Government has chosen an alternative method for tapering the obligation. This is illustrated below and is shown relative to the "cliff-edge" option described above. In effect the tapering approach will involve a supplier receiving zero "points" for their first 400 GWh of electricity supply or 2,000 GWh of gas supply, two "points" for their second 400 GWh electricity or 2,000 GWh gas supply and one "point" for all supply above 4,000 GWh of gas or 800 GWh electricity[181]. The share of the obligation for each supplier will then be the proportion of "points" they have.

**Figure 45** Share of the obligation for a small supplier participating in the ECO




## Brokerage

The ECO and Green Deal finance markets are expected to be closely interlinked. Given that a large number of expensive measures such as SWI will require ECO subsidy as well as Green Deal finance, the small number of energy suppliers who will be responsible for fulfilling the ECO could have a large influence on the Green Deal and ECO market.

Whilst it is difficult to predict how energy companies will operate in order to meet their obligation, there is a risk that they will behave in ways which limit competition in the Green Deal provider market, which could increase the costs of meeting the ECO in the long run. In particular, energy companies may channel ECO spending through their own Green Deal provider business to gain market share or only partner with a few large Green Deal providers.

[181] These figures are based on data published by Ofgem which suggests the typical household consumes 16,500kWh energy using gas as a fuel source and 3,300kWh using electricity and would be recalculated periodically by the ECO administrator. See www.ofgem.gov.uk%2FMedia%2FFactSheets%2FDocuments1%2Fdomestic%2520energy%2520consump%2520fig%2520FS.pdf&ei=0JktT4TXLKnE0QX39I2tCA&usg=AFQjCNH7N3NHxb1yUy_stO9zLif5fT6Urg.

The Green Deal and ECO consultation set out Government's preferred approach of setting up a market based mechanism – a brokerage – to provide a fair and transparent mechanism to allow Green Deal providers access to ECO spending. Government is currently working with stakeholders and industry experts to design the brokerage such that it is attractive to all market players, helping to minimise the cost associated with meeting the ECO. Brokerage will be the subject of a further consultation in Summer 2012.

## Scoring of Boiler Repairs for Affordable Warmth Obligation

We consulted on the question of whether to include boiler repairs within the Affordable Warmth obligation. The inclusion of boiler repairs would allow for non-working boilers to be fixed where it is cost-effective to do so (rather than installing a more costly replacement boiler). However, the inclusion of boiler repairs would introduce the risk of large amounts of AW compliance being achieved through essentially very low cost repairs (which could imply a significant level of deadweight).

In order to ensure that savings from repairs are realised, we are proposing that repairs can only be carried out under the following conditions:

- Repairs are limited to A and B rated boilers
- Repairs require a warranty of one or two years and will score accordingly (i.e. a boiler that is repaired and which comes with a one-year warranty will score one year's worth of notional heating cost reduction)
- An overall limit will be set on the proportion of the Affordable Warmth obligation target that can be met by boiler repairs. This will be set at 5% of the overall AW target.

We will continue to monitor activity in this area, which will inform the design of the next phase of the ECO.

## Household Eligibility for Affordable Warmth support

The consultation set out a number of options for qualifying criteria for support under the Affordable Warmth target, based on combinations of receipt of means-tested benefits and associated disability premiums,[182] and living in private tenure. These criteria also included elements of restrictions on dependent's ages. Respondents to the consultation largely agreed with the use of means-tested benefits to set the qualifying criteria, and there was general support for expanding the size of the eligible group. The consultation also asked for views on the inclusion of Working Tax Credit as an additional qualifying benefit, and the possibility of raising the age restrictions on dependents.

[182] Specifically, people who are in receipt of state Pension Credit, Child Tax Credit under the 'free school meals' income threshold, or people in receipt of either Income Support, Income Related Employment and Support Allowance (if receiving the work-related activity or support component), Income Based Jobseeker's Allowance and at least one of the following: parental responsibility for a child under the age of 5 who ordinarily resides with the person, child tax credit which includes a disability or severe disability element, a disabled child premium, a disability premium, enhanced disability premium or severe disability premium, a pension premium, higher pension premium or enhanced pensioner premium.

Drawing on data from the English Housing Survey, analysis of the prevalence of fuel poverty in low income households living in both private and social tenures shows a much higher concentration of fuel poor households in private tenure.

**Fuel Poverty rates in low income households, by tenure in England, 2009**

| Group | Number of Non-Fuel Poor Households (mn) | Number of Fuel Poor Households (mn) | All Households (mn) | % Fuel Poor |
|---|---|---|---|---|
| Private Tenure Income <£16k | 2.4 | 3.3 | 5.6 | **59%** |
| Social Tenure Income <£16k | 1.8 | 0.8 | 2.6 | **34%** |

Source: English Housing Survey (2009)

Further analysis of the prevalence of low energy efficiency among low income households within the two tenures shows a significantly greater concentration of inefficient housing (using an inefficiency threshold of SAP 55) in private housing compared to the social sector.

**Proportion of dwellings below SAP 55, by tenure in England, 2009**

| Group | All Households (mn) | Number of households below SAP55 | % of households below SAP55 |
|---|---|---|---|
| Private Tenure Income <£16k | 5.6 | 3.3 | **58%** |
| Social Tenure Income <£16k | 2.6 | 0.6 | **24%** |

Source: English Housing Survey (2009)

We have therefore decided to proceed with the proposal in the consultation to focus eligibility for Affordable Warmth on private tenure only.

Two options are under consideration in relation to the qualifying benefits for Affordable Warmth:

Option 1: Consultation Proposal: Adopt the eligibility criteria proposed in the consultation.

Option 2: Expand the eligible group: include those claiming Working Tax Credit (under an income threshold of £16,000) and raise the qualifying age threshold for dependent children from 5 to 19 (if in full time education).

Analysis of the two options indicates that including Working Tax Credit and raising the age threshold for dependent children increases the number of eligible households significantly by 4% (or around 100,000 households), without having a material impact on the focus of effort on those in fuel poverty (the Fuel Poverty 'Hit Rate').

**Total Number of Households and Fuel Poverty Hite Rates for AW eligibility options**

| Group | Total Number of Households (GB) | Fuel Poverty Hit Rate |
|---|---|---|
| Option 1 | 2.6m | 55% |
| Option 2 | 2.7m (+4%) | 53% |

As a result, Government has decided to expand the eligible group to include those households claiming certain benefits who also have children under the age of sixteen or up to 19 years old if in

'non-advanced' education as well as those on working tax credit who meet other caring, disability or age criteria.

We estimate that as a result opportunities are now 2.2 million insulation measures and 1.7 million heating measures over the policy lifetime.[183]

## Target Metrics

### Using a SAP-based scoring methodology

In the consultation we proposed using a SAP-based scoring methodology to calculate savings made through the installation of measures under ECO, both in terms of carbon savings and notional expenditure. Currently under CERT, carbon savings are calculated using the BREDEM model. This provides a set of reference circumstances for each measure based on typical savings which do not take into account the specific details of each property.

Under the ECO we are expecting a range of more significant and expensive interventions to be delivered and we would expect that the impact of these measures on carbon emissions would vary significantly from house to house. There is therefore an argument for the ECO to use a property-specific assessment using the same SAP-based methodology and assessor accreditation standards as used for the Green Deal. This approach will ensure consistency between the ECO and Green Deal. As ECO measures will in general be long lasting, calculations should be based on standard occupancy patterns rather than attempting to take specific household circumstances into account.

### Life-time versus annual scoring

The consultation asked for views on whether targets and scores for the ECO carbon saving obligation should be expressed on the basis of the annualised or the lifetime savings of measures.

The SAP-target scoring methodology generates projected savings on an annualised basis. However, there are advantages for the Carbon and Affordable Warmth objectives in terms of helping to ensure the delivery of the most cost-effective measures in factoring in the expected lifetime of measures. This would align the scores measures received as closely as possible to the extent to which these measures contribute to the policy outcome of reducing annual carbon emissions or fuel bills.

The final policy decision is for ECO measures under the three obligations to be scored on a lifetime basis. A unit of $CO_2$ saving from a Cavity Wall Insulation with an assumed lifetime of 42 years would therefore generate [1 unit of $CO_2$ x 42 years] units of delivery towards their carbon target. For the purpose of the modelling, it has been assumed that 1t$CO_2$ lifetime carbon saving from the installation of an eligible insulation measure generates 1 ECO carbon target point. Progress towards AW targets (ECO AW points) are estimated by multiplying the SAP-based notional reduction in space and water heating costs in year 1 from heating and insulation measures by the estimated lifetime of measures, to generate a lifetime notional heating cost reduction. For example, a 1 unit £ reduction in notional space and water heating costs from a new heating system with an assumed lifetime of 12

[183] Since the consultation analysis of the eligible group, our estimate of the size of the proposed AW group is smaller than previously estimated. This is a result of improved techniques in correcting for the underreporting of benefits in the English Housing Survey, which allows more accurate matching of those in receipt of multiple benefits.

years would generate [1 unit £ cost reduction x 42 years] = 42 ECO AW points.[184] The detailed lifetime assumptions for both heating and insulation measures are provided in Table 58.

[184] The exception to this rule is when replacing broken boilers in Affordable Warmth eligible households. In such instances, the broken boiler (which the SAP methodology would treat as functional) will be treated as absent and the new replacement boiler would be assumed to be replacing electric secondary heating.

## Annex I: Interest Rates

The interest rate affects how much finance can be raised and the total cost the consumer must repay. For example, for a £500 measure repaid over five years, interest payments at 7.5% would total about £120, whereas at 10% the interest component would be around £160 and annual bill savings would need to be £8 higher to meet the Golden Rule.

The interest rate breaks down into three parts. First, the lender has their own funding cost: the cost at which they can obtain the money to lend. A margin is then added, called the credit risk premium, to cover the expected losses from the loan book as a whole. Finally there is a residual cost, made up of the lender's profit margin and any loan administration costs.

To minimise these costs, Green Deal providers are exploring options to aggregate Green Deals into a Special Purpose Vehicle (SPV). The vehicle would raise capital from investors to fund Green Deals and repay this using the Green Deal repayments. This has several advantages:

- It should minimise funding costs. The cheapest sources of long-term debt finance is found in the capital markets. In order to cost effectively access the capital markets, sufficient scale is required. By aggregating Green Deals into an SPV, that scale can be achieved and consumers should ultimately benefit through a lower interest rate.

- Aggregation should also minimise residual costs. Green Deals may have long repayment periods so admin costs could be significant. By achieving funding at scale, overheads per loan are reduced.

- For each Green Deal someone must provide the funding for it. The aggregator SPV described above means providers need not do this. As such, providers thinking of entering the Green Deal market, who are unlikely to be in the business of finance, will not be put off by having to carry the funding liability on balance sheet.

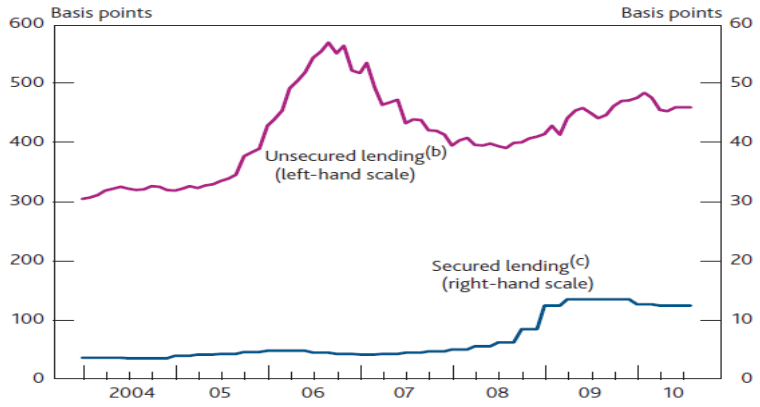
However, the aggregator cannot improve the credit risk of the underlying Green Deals. The risk might be expected to be small as charges will be attached to electricity bills where default loss is low (1.5%-2%). The Green Deal's novel aspects mean default rates may not be identical to those on fuel bills (see box on defaults below). As such, the market is likely to take a conservative view until there is a track record. To mitigate this, the possibility of obtaining investment from the Green Investment Bank (GIB), during that start-up period, is being explored. Green Deal is a stated early priority for the GIB.

Independent analysis suggests that an interest rate of 6-8% is possible, depending on the level of GIB investment and on a suitable aggregation structure being agreed. The most developed potential aggregator, called The Green Deal Finance Company, has a central estimate of 7.4%. We therefore use 7.5% as a central rate in our modelling, with a low rate of 6.5% and a high rate of 9.5%. The latter reflects the contingency that an aggregator SPV does not come into being as anticipated and hence providers have to fund Green Deals on their own balance sheet.

### Defaults and the Green Deal interest rate

Default expectations determine credit risk and hence will be a crucial component of the final Green Deal interest rate. Three factors determine the exact relationship: default probability, loss given default and the correlation of defaults over time. Green Deal defaults should be similar to those on energy bills as the charge is attached to the electricity meter and ranks *pari passu,* meaning suppliers have as much incentive to collect it as they do the rest of the bill. Data suggests energy bill default loss is about 1.5%-2% of revenue. If the Green Deal is similar, this would be a low rate for an unsecured credit product, equivalent to 150-200 basis points on the chart below:

***Expected Loss Component of Credit***




***Risk***

Source: http://www.bankofengland.co.uk/publications/quarterlybulletin/qb100301.pdf
(b) Expected loss for personal loans – all products.
(c) Expected loss for 75% loan-to-value mortgages – all products.

So, based on the credit risk of current energy bills, we might expect the Green Deal to have an interest rate somewhere between the rates for secured and unsecured lending above. Bank of England data puts these rates at about 4% for secured lending (5-year 75% loan-to-value mortgages) and 15% for unsecured lending (the average rate on personal loans of £5,000). However, until the Green Deal establishes a default track record to this effect, the market cannot use energy bill defaults as a direct proxy for Green Deal defaults and will hence price the risk more highly. This is why GIB investment is being sought; to keep the interest rate at the level it is likely to be once track record is proven. The reasons for market uncertainty are listed below.

a) **Adverse selection**. Green Deals may be offered at the same rate to all, meaning they may be most attractive to those without access to superior forms of credit. Without scale, the Green Deal could thus have a lower average credit rating and a higher default probability than for the entire population with energy bills.
b) **Performance of measures**. Unlike provision of energy generally, Green Deal payment will rest on the customer's view that the product is performing to standard, creating an extra risk – though the pari passu provision will mean they cannot pay only the energy element of the bill.
c) **Void Periods.** Whilst the current bill payer always remains liable for payment of the charge, Green Deal repayments may be interrupted by void periods, particularly in the private rented sector.
d) **Disclosure**. The charge may be written off in some cases if not properly disclosed on change of ownership.
e) **Early Repayments**: Early repayment reduces the cash-flow due to early termination of the plan.
f) **Electricity Bill vs Gas Bill**. Most bill savings accrue through gas bills, so customers not on dual fuel packages may see their electricity bills increase.

## Annex J: Green Deal Eligible Measures

We asked consultees for views on which measures should be added to the list of Green Deal Eligible measures with particular relevance to non domestic buildings. An additional 13 measures were added. Certain measures will not be recommended for different types of buildings, as they are not appropriate or are not modelled in the appropriate methodology (SBEM or SAP).

A statutory instrument will set out a final list of the qualifying measures. Below is a current draft list:

Air source heat pumps
Biomass boilers
Biomass room heaters (including with radiators)
Cavity wall insulation
Cylinder thermostats
Draught proofing
Duct insulation
Hot water showers
Hot water systems
Hot water taps
External wall insulation systems
Fan-assisted replacement storage heaters
Flue gas heat recovery devices
Ground source heat pumps
Heating controls (for wet central heating system and warm air system)
Heating ventilation and air-conditioning controls (including zoning controls)
High performance external doors
Hot water controls (including timers and temperature control)
Hot water cylinder insulation
Internal wall insulation (of external walls) systems
Lighting systems, fittings and controls (including rooflights, lamps and luminaires)
Loft or rafter insulation (including loft hatch insulation)
Mechanical ventilation with heat recovery
Micro combined heat and power
Micro wind generation
Pipe-work insulation
Photovoltaics
Chillers
Gas-fired condensing boilers
Replacement glazing
Oil-fired condensing boilers
Warm-air units
Radiant heating
Roof insulation
Room in roof insulation

Sealing improvements (including duct sealing)
Secondary glazing
Solar water heating
Solar blinds, shutters and shading devices
Transpired solar collectors
Under-floor heating
Under-floor insulation
Variable speed drives for fans and pumps
Waste water heat recovery devices attached to showers
Water source heat pumps

# Annex K: Post Implementation Review

A Post Implementation Review (PIR) should examine the extent to which the implemented regulations have achieved their objectives; it should also assess their costs and benefits and identify whether they are having any unintended consequences. As such, the PIR Plan is detailed below.

### *Basis of the review:*

Given the innovation in the Green Deal/ECO policy framework and the inevitable uncertainty which comes with this, there is a strong commitment to monitoring and evaluation. Understanding what works, by how much, and why, will be important if government (and the market) is to be able to refine these policies over time.

The details of this process will be set out in the Green Deal and ECO Monitoring and Evaluation Strategy, to be produced in Spring 2012.

Longer-term, the key concern will be the impact of the Green Deal and ECO in terms of carbon and/or energy (and associated bill) reductions. But in the short term, we will be equally interested in how the supply and delivery chain is engaging with the Green Deal and ECO framework, and how the framework is supporting this.

This suggests 3-4 milestone reporting points, in addition to regular statistical output and monitoring:

- pre-launch during 2012 (baseline)
- immediate period post-launch ("one-year on", end-2013 to mid-2014); and
- medium to long-term after launch (3 and 5 year reviews)

### *Review objectives:*

The review process has two broad aims: to examine the implementation and *process* of the policy framework so that any necessary improvements can be made quickly and with sufficient evidential support; and to measure the *impact* of the policy framework against pre-agreed objectives:

- To create a market framework removing financial and quality assurance barriers for consumers, and allowing for new entrants into the market for energy efficiency in housing and non-domestic buildings;
- To remove barriers to the supply of private finance to this market framework, including ensuring market confidence that there will be sufficient scale of demand to enable efficient financing in the first two years of Green Deal;
- To ensure ECO delivers cost effective carbon abatement in the housing sector in the second and third carbon budget periods.

It is expected that early monitoring and evaluation is likely to focus on process and later reviews will consist more of impact evaluation, though key indicators will be monitored throughout.

### *Review approach and rationale:*

There will be different types of monitoring and evaluation required at each stage of implementation pre and post launch. We anticipate that a range of methods will be deployed. For process evaluation, the following techniques are likely to apply:

- Ongoing monitoring of key indicators (number of Green Deals, total investment made, resulting carbon reduction, bill payments, price of ECO points etc)
- Omnibus Surveys to monitor general consumer awareness and attitudes to desirability and process of Green Deal
- Bespoke surveys of participants, such as Green Deal assessors and Installers
- Qualitative focus group work
- Process evaluation studies of different parts of the delivery chain, to understand in depth how these participants are planning/carrying out delivery
- Baseline and follow-up studies for particular sectors
- Researchers could also be deployed to assess training and development activity, or to map the processes being developed by participants

For impact evaluation, the above techniques are likely to be supplemented by:

- The construction of a robust counterfactual using bespoke survey data and/or statistical techniques as set out in the Magenta Book
- Statistical/econometric analysis of data to assess performance relative to counterfactual
- Technical monitoring of the performance of individual measures and packages in-situ, post-installation to verify that estimated energy and carbon savings match actual savings
- Further data analysis to determine distributional impacts.
- Cost-benefit analysis.

### *Baseline:*

As set out above, considerable analysis will be conducted to establish both a robust baseline and counterfactual i.e. an estimation of how the baseline would progress in the absence of the policy. By measuring against these, performance can then be attributed to the policy framework with some confidence.

Baseline and counterfactual levels will be investigated in a number of areas, using the techniques set out above. These include:

- The number of measures installed and hence estimated carbon reduction
- Amount of energy efficiency investment
- Bill payments
- The state of the energy efficiency market (including job levels)
- The value of energy efficiency products within house prices/rental values
- Consumer attitudes (e.g. trust of installers, general attitudes to energy efficiency, finance etc)

### *Success criteria:*

The Green Deal will be a (largely) market financed and market driven offer to consumers and businesses and therefore the policy framework that aims to create this new market is not subject to

any specific targets. The purpose of the review process is to evaluate (cost) effectiveness in general terms.

However, the review will certainly attempt to estimate the policy framework's contribution towards macro-level carbon reduction targets to which the UK is committed. In addition, the nature of the ECO means each energy supplier is committed to provide a specific level of carbon reduction and the review would certainly look to assess any failure in this regard and the reasons behind it.

### *Monitoring information arrangements:*

The aim is to accurately capture hard output data from across the programme, without placing additional burden on participants. The principle will be to "collect once, use many times" and to "harvest" useful data from participants management information.

We have identified the key variables that will require frequent monitoring, which will reflect the full operation of the Green Deal. For example, the

- Number of Green Deal Providers; Assessors and Installers;
- Number of assessments and the number of plans taken out (conversion rates);
- Volume of Green Deal finance issued by providers;
- Number of measures installed;
- Number of complaints and what these relate to.

We are developing a reporting template for consultation with key stakeholders, which will also consider regularity of reporting and the intended audience. The requirements and application of the Data Protection Act in the context of the Green Deal have been identified and work is on-going within DECC to ensure that the Department is fully compliant.

Data will be collected at an individual household level, so we will be able to monitor and report at various levels of geography, potentially down to Lower Level Super Output Area (approx 400 households in each area). For regular monitoring reports it is envisaged that data will be published at a higher level geography, to ensure the information is easy to digest.

The key data sources will be:

- Management information from Energy Efficiency Advice Service
- The EPC Register and Database (Landmark)
- Green Deal Central Charge Database
- National Energy Efficiency Database
- Data from the Registration and Oversight Body
- Data from the ECO Administrator
- Complaints data from the Redress scheme
- English Housing Survey, Scottish Housing Condition Survey, Living in Wales Survey.
- Digest of United Kingdom Energy Statistics (DUKES)

### *Reasons for not planning a review:*

N/A

# Annex L: Subsidy Research Summary

### *Context*

Research was undertaken to investigate whether a high rate of subsidy has a proportionally larger impact on consumer uptake of the Green Deal.

The purpose of the research was to determine peoples' preference for a home improvement package of cavity wall insulation or solid wall insulation (depending on which they needed) given different levels of subsidy (and corresponding net bill savings).

### *Methodology*

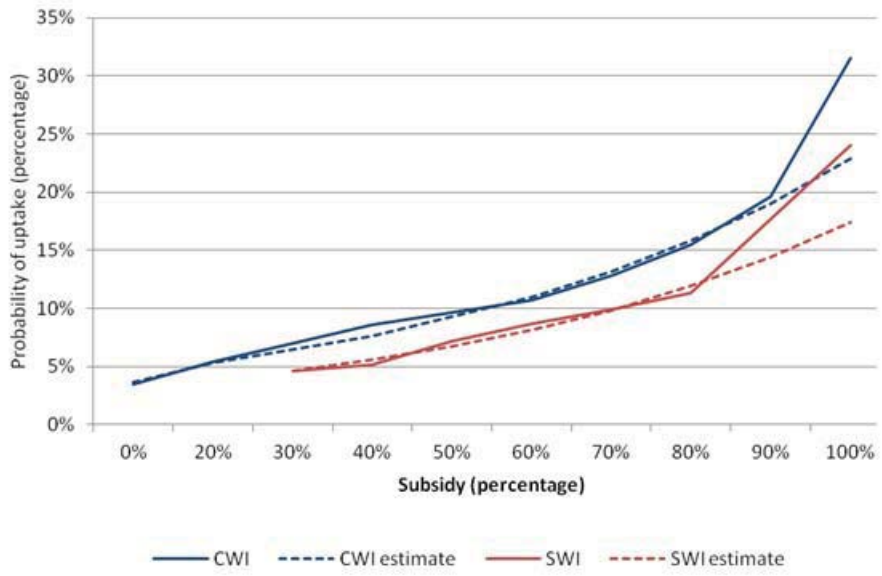
A series of questions were included on GfK NOP's weekly Random Location Omnibus (RLO). It is designed to be representative of the population in terms of age, sex, social class and region. Interviews were conducted face to face in respondents' homes using Computer Assisted Personal Interviewing (CAPI) . Only owner occupiers and private rented tenants were included in the research.

Respondents who needed either cavity wall insulation or solid wall insulation were given information about the Green Deal and asked, at a series of varying subsidies and annual bill savings, how likely they would be to take up the product at each of the subsidy levels. The order in which subsidy levels were shown was randomised to avoid any bias and order effect. The method is a standard pricing technique known as Gabor-Granger.

Fieldwork took place in November 2011. A total of 1,946 people were interviewed in the omnibus survey. However, some were removed from the sample because they were not suitable, e.g. they did not own their property or rent from a private landlord etc. This resulted in a final sample of 1,095 respondents answering the preference questions.

## *Findings*

**Figure 46: Relationship between subsidy rates and consumer demand for insulation measures**




The results are shown in the figure above. The dotted lines show the estimate of uptake based on original survey data generated from the 2011 Green Deal consumer survey, and the solid lines show uptake based on this survey. The difference between the dotted lines and the solid lines indicate that, a higher rate of subsidy does have an impact on uptake for the two measures tested - cavity wall insulation and solid wall insulation, according to the survey.

The results were compared with a prediction based on the lower rates of subsidy and this information was used in the Green Deal Household Model. Further explanation of this is provided in Annex B.

# Annex M: Funding Home Improvement Research Summary

### *Context*

The purpose of the research was to provide an indication of the sources of funding that consumers have used and might choose to use in the future for funding home improvements. This information was used to inform the low Green Deal finance scenario in the modelling. There are a number of caveats to note with this research:

1. Questions were not set in the context of the Green Deal, nor set in the context of real financial alternatives . Decisions were made by customers in the absence of any information on the availability of Green Deal finance and its benefits.
2. Respondents were asked questions about making general 'improvements to their home' rather than focusing specifically on energy efficiency improvements.

### *Methodology*

A series of questions were included in GfK NOP's weekly Random Location Omnibus (RLO). It is designed to be representative of the population in terms of age, sex, social class and region. Interviews were conducted face to face in respondents' homes using Computer Assisted Personal Interviewing (CAPI) . Only owner occupiers and private rented tenants were included in the research.

Fieldwork took place in February 2012. A total of 1,880 interviews were interviewed in the omnibus survey. Full interviews were only conducted with those who owned or rented their property and were responsible or jointly responsible for financial decision making in the household. This resulted in a final sample of 1,087 people.

### *Findings*

When respondents were asked about all the things they had done to their property in the last 12 months, 41% of people had made some form of home improvement, and 18% of people had installed one or more energy efficiency measure(s). 59% of respondents had made no form of improvements to their home in the last 12 months.

Of those who had done anything to their property in the last 12 months (general home improvements or energy efficiency measures), the majority of people (83%) paid for the improvements upfront e.g. via savings. 13% of people used a form of finance (e.g. a loan), 3% used part financing (i.e. some finance, some upfront) and 5% used another method of payment (e.g. someone else paid for it).

When asked to consider a hypothetical purchase for home improvements of £500, only 9% said they would use finance. This rose to 20% when the cost was £2,000 and to 30% when the cost was £5,000. These results are broadly consistent with other UK and US evidence.