BETTER HOMES

INCENTIVISING HOME ENERGY IMPROVEMENTS

Sam Hall and
Ben Caldecott

bright blue

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Executive summary

The UK government urgently needs to take steps to incentivise improvements to households' energy consumption. The end of the government's Green Deal in 2015 has left a deficit of policies for encouraging home energy improvements. 'Home energy improvements' are important because they provide various private benefits (such as cheaper energy bills in the long-term, better health outcomes, and more financially valuable properties) and public benefits (such as greater energy security, lower carbon emissions, and an economic stimulus). In particular, if the government is to meet its target to reduce carbon emissions by 80% by 2050, considering that residential buildings constitute 22% of emissions, then many more homes will need such improvements.

As will be outlined in Chapter One, home energy improvements are both demand-side and supply-side measures, enabling households to consume both less and greener energy. There are a number of measures that households can install to improve their energy use. This report will concentrate on two principal types of measures: 'energy efficiency measures' and 'decentralised renewables'. We focus on the 'able to pay' sector, which, for the purposes of this report, we define as the 13.2 million owner-occupier households in the UK that are not 'fuel poor'. We recognise, however, that there are some low-income households that are not officially fuel poor, but struggle to pay their fuel bills. Earlier this year, the Government published proposals to reform the Energy Company Obligation (ECO), which will mandate energy suppliers to install energy efficiency measures in the homes of the fuel poor.

Focus of this research and the methodology

This report addresses the following research questions:

1. What are home energy improvements, the advantages and disadvantages of different measures, and the recent trends in their deployment?
2. What are the main experiences and policy lessons from the Green Deal?
3. How can the government encourage more home energy improvements, in particular deep retrofits?

In order to answer these research questions, we employed a number of methods, described in detail in Chapter Two. First, we conducted an extensive literature review of the main UK and international evidence. Second, we conducted a number of interviews with independent experts, government officials, and industry practitioners. Third, we hosted a number of events to discuss the key themes and policy ideas in this area, including an invite-only roundtable discussion with leading decision makers and opinion formers, and a meeting of the advisory board of Bright Blue's *Green conservatism* project. Fourth, we put out a call for written evidence for our home energy improvement project and received 19 submissions from a range of organisations, which we include in the annex of this report.

These research methods enabled us to identify: the different home energy improvements available, their benefits and disadvantages, and the recent trends (Chapter Three); and the experiences and policy lessons of the Green Deal (Chapter Four).

Attributes of and trends in home energy improvements

Energy efficiency measures

This report focuses on four energy efficiency measures:

- **Solid wall insulation.** This measure adds insulation material to either the inside or outside of solid walls to trap heat. It has the greatest energy saving potential of £331 per year on the fuel bills of an average household, but also the highest installation cost of between £4,000 and £14,000. It has had the least progress of any measure with just 340,000 solid wall properties insulated in Great Britain. There are still 7.5 million solid wall properties without insulation.
- **Cavity wall insulation.** This measure injects insulation material into the gap between a property's two walls to trap heat. It saves an average household £165 per year on their fuel bills, which is less than the potential saving for solid wall insulation. But it has a lower cost than solid wall insulation of between £500 and £1,500 to install. The uptake has been strong to date with 14.3 million cavity walls insulated in Great Britain, and 4.7 million without insulation.
- **Loft insulation.** This measure places a layer of insulation material on the floor of a property's loft to stop heat escaping through the roof. It saves an average household £121 per year on their fuel bills, and it has the lowest cost of any the energy efficiency measures we examine of between £100 and £350. Progress has been good with nearly 17 million lofts now insulated in Great Britain. But there is still great potential for further installations with seven million lofts still requiring additional insulation.
- **Double glazing.** This measure replaces a home's windows with two glass panes, separated by a small gap, which traps heat. It has the smallest saving for an average household of £71 per year on their fuel bills. For such a small energy saving potential, it has a relatively high cost of between £3,300 and £6,500 to install. 81% of English households have had double glazing installed.

Decentralised renewables

This report focuses on three main decentralised renewable heat

technologies and two main decentralised renewable electricity technologies.

Renewable heat technologies

- **Heat pumps.** Heat pumps remove heat from outside sources using electricity. Ground-source heat pumps extract heat from the ground and their installation requires a large outdoor space. Air-source heat pumps extract heat from the air and have fewer space requirements. They both have lower fuel costs than conventional gas boilers, and utilise existing electricity infrastructure. But there are two principal barriers to take-up. First, high upfront cost: ground-source heat pumps cost between £9,000 and £17,000 and air-source heat pumps cost between £3,000 and £10,000. Second, heat pumps do not have high flow temperatures, meaning that to provide a home with sufficient heat, the property must be very energy efficient. This can require the retrofitting of more energy efficiency measures, together with more radiators. Air-source heat pumps are the most popular renewable heating solution, with 22,000 installations to date under the Renewable Heat Incentive (RHI), the government's subsidy scheme to support domestic renewable heating. But ground-source heat pumps are the least popular measure, with just 7,000 installed so far under the RHI.
- **Biomass boilers**. Biomass boilers burn renewable organic material, such as wood pellets or purpose-grown crops, to produce heat. Unlike heat pumps, they are able to provide similar flow temperatures to condensing gas boilers. There are two main barriers to uptake. First, they have a high upfront cost of between £7,000 and £13,000. Second, there is limited availability of sustainable biomass that doesn't compete with food crops and increase overall carbon emissions. Twelve thousand biomass boilers have been installed under the RHI to date, making it the second most popular renewable heating technology.
- **Solar thermal panels.** Solar thermal panels fixed on a home's

rooftop produce heat using energy from the sun. They are the lowest cost renewable heat technology, ranging from £4,000 to £6,000. The main barrier to uptake is that they only produce heat intermittently, and cannot be relied upon during winter. Eight thousand installations of solar thermal panels have been accredited under the RHI to date.

Renewable electricity technologies

- **Solar photovoltaic (PV) panels.** Solar PV fixed on a home's rooftop produce electricity using energy from the sun. The upfront cost of solar PV has fallen dramatically in the last four years by over 40%. The average cost of an installation is now £6,750. There have been over 800,000 installations of solar PV in homes under the Feed-in Tariff (FIT) scheme, the government's subsidy scheme to incentivise decentralised renewable electricity. Domestic solar PV represents around 3% of the UK's total electricity generating capacity.
- **Battery storage.** This technology allows electricity to be stored until there is demand and can be effectively combined with household solar PV. It can overcome the problem of solar being intermittent, enabling households to consumer more of the electricity that they generate. Battery storage is currently rare in the domestic sector, but costs are falling. For instance, Tesla's Powerwall domestic battery has recently been launched and is sold for $3,500 in the US.

Take-up of energy efficiency measures has been mixed, with good progress on the cheaper measures, but little progress on solid wall insulation. It is estimated that 10% of the UK's carbon emissions could be saved by installing all the potential energy efficiency measures in the domestic sector. Renewable heating technologies have had very poor take-up, with just 2.5% of the UK's heating demand coming from low-carbon sources. Air-source heat pumps have the greatest potential for

widespread deployment. While the deployment of the main renewable electricity measure, solar PV, has been impressive in recent years, there is still very significant scope for further installations. New government policies will be required to accelerate all these improvements and to ensure that important carbon emissions targets are achieved.

Why the Green Deal failed

The Green Deal was launched in 2013 to encourage able to pay households to invest in a range of home energy improvements, including those outlined above (excluding battery storage). The then Energy and Climate Change Minister declared the ambition "to improve 14 million homes by 2020 and a further 12 million by 2030". The Green Deal allowed households to finance home energy improvements with a loan that was repaid through their energy bills. The 'Golden Rule' limited the amount that could be borrowed such that the loan repayments could not exceed the estimated savings in energy bills from the measures. The advantage of this innovative financing mechanism was that it helped to remove the upfront cost of measures to consumers.

However, the Green Deal had its funding withdrawn in mid-2015. It is widely regarded to have failed. This report identifies four principal failures:

- **Low take-up.** Despite the ministerial ambition for the scheme, only over 15,000 or so Green Deal finance plans were signed between 2013 and 2015. These funded around 20,000 home energy improvements.
- **Failure to leverage private investment.** 97% of home energy improvements between 2013 and 2015 were paid for by the Energy Company Obligation (ECO) or one of the government's subsidy schemes. Just 1% of the measures was funded by Green Deal finance.
- **High cost to the taxpayer.** The total cost to the taxpayer of the Green

Deal was £240 million. This amounted to a public subsidy of £17,000 for each Green Deal plan that was agreed.

- **Poor interaction with ECO.** ECO, under which energy suppliers were mandated to install free energy efficiency measures, often acted in competition with the Green Deal. Instead of blending with Green Deal finance to fund more expensive measures, households chose to install measures just using ECO.

The Green Deal's most significant shortfall was poor take-up. We set out four possible reasons for such low consumer demand:

- **Unattractive financial product.** Average interest rates for the Green Deal were between 7% and 10%. This was an unattractive rate of interest compared to other forms of finance available to owner-occupiers, such as mortgages. It was also unappealing when many able to pay households have savings they can use to fund home energy improvements. The combined effect of high interest rates and long payback period of up to 25 years was that a large amount of the total borrowed amount was financing costs. This was not a compelling financial proposition to consumers. As a result of the Golden Rule constraint, the average size of a Green Deal loan was just £3,500, insufficient to finance expensive measures like solid wall insulation or a heat pump. This left consumers with an uninspiring set of options they could fund without paying an upfront lump sum to meet the Golden Rule. It also prevented the financing of deep retrofits under the scheme, which are required if the UK is going to meet its legally-binding carbon emissions targets.
- **Poor communication of the scheme.** The communication of the scheme focused excessively on the scheme's finance mechanism, rather than the merits of the product itself. Consumer research has found that comfort, health, and well-being are more effective ways to communicate the benefits of home energy improvements.

- **Poor consumer journey.** The design of the Green Deal failed to take advantage of natural opportunities for improvements, or 'trigger points', such as when a property is sold. Consumer research has found that households are generally reluctant to agree to the disruption of renovations, and that households are more likely to do home energy improvements as part of other renovations. Consumers also found the Green Deal process burdensome and complex, with just 2.5% of Green Deal assessments resulting in a Green Deal plan being agreed.
- **Problems with the supply chain.** Some consumers reportedly experienced poor quality Green Deal installations, which undermined confidence in the scheme. Around 11% of Green Deal assessors and 14% of Green Deal installers were suspended from the scheme because of poor workmanship. Supply chain research has also revealed several barriers to new entrants: the high registration fee to become accredited, the complexity of the accreditation scheme, and the political uncertainty over the longevity of the Green Deal scheme.

New policies

In Chapter Five, we make eight policy recommendations. These are aimed at addressing the reasons we identified for low take-up of home energy improvements under the Green Deal.

The policies we propose stem from two fundamental principles. First, recognising fiscal realism: although we do not shy away from proposing policies that carry a cost, available funding is constrained by the government's current fiscal position. Second, stimulating the market: as the Green Deal failed to boost consumer demand, policies must successfully leverage private investment into home energy improvements, enable small businesses to flourish, and ultimately boost the productivity of the economy.

Improving the communication of the scheme

Recommendation one: introduce a new home improvement scheme

We propose that the successor scheme to the Green Deal is rebranded as a home improvement scheme. The old branding no longer has the confidence of the public and relied too much on consumers' being environmentally motivated. The new scheme should be seen as mainstream home improvement, which increases comfort, quality of life, and the value of the property. There should be a national network of one stop shops to communicate the scheme to consumers, provide them with all the information they need, and reduce the complexity of the multi-stage process. In addition, the range of eligible home energy improvement measures for the scheme should be expanded to include smart appliances and battery storage, as well as energy efficiency measures and decentralised renewables.

Making the finance package more attractive

Recommendation two: introduce 'Help to Improve' loans

We propose that the government offer 'Help to Improve' loans to households, which would be a sister policy to 'Help to Buy'. These loans would utilise the 'pay as you save' mechanism from the Green Deal, but would be larger (see recommendation four below) and have much lower interest rates. The loans should be underwritten by the government using the UK Guarantees scheme for infrastructure, which would reduce the interest rate below what it was under the Green Deal by passing on the government's low borrowing costs. This major investment in the UK's infrastructure would provide a quick stimulus to the economy while there is uncertainty following the EU referendum, and increase productivity. The evidence from Germany, where the government also provides low interest loans to individuals, is that the Treasury would over time see a return on its investment.

If the government wanted to control the short-term costs of the scheme, a cap could be placed on the number of loans underwritten or the size of loans that households could take out. Given the Green Deal Finance Company is being sold, high-street banks could provide the loans for the new home improvement scheme.

Recommendation three: introduce a new 'Help to Improve ISA'

We propose that a 'Help to Improve ISA' is established to incentivise households to save for home energy improvements, which would be a sister policy to the 'Help to Buy ISA'. The government would top up dedicated household savings for home energy improvements by a fixed percentage. This could be used to reduce the overall amount borrowed under the scheme or the size of the loan repayments.

Recommendation four: scrap the 'Golden Rule' on home improvement loans

We propose removing the 'Golden Rule' in the new home improvement scheme, which prohibited loan repayments from exceeding the estimated bill savings from the installation of the measures. Scrapping the Golden Rule would enable an attractive combination of energy efficiency measures, decentralised renewables, battery storage, and smart appliances to be financed by the new home improvement loan without an upfront lump sum being required. The Golden Rule was an unnecessary consumer protection. Households should be given guidance if their bill might go up and by how much, making clear the assumptions used. We should be providing consumers with the necessary information to make an informed decision and avoid being paternalistic. Moreover, a similar loan scheme in Germany has seen a very low default rate and credit checks for new home improvement loans would still be required.

Recommendation five: integrate revenue households receive from the Renewable Heat Incentive (RHI) and Feed-in Tariff (FIT) into the new home improvement scheme

If households choose to finance the upfront cost of decentralised

renewables with a new home improvement loan, the revenue they qualify for under the RHI and FIT could be discounted from the amount they repay each week. As subsidies via the RHI and FITs are gradually phased out as renewables become cost competitive without subsidy, home improvement loans could become the primary means for government to support their deployment in the domestic sector. Even if renewables are cost competitive without subsidy – as they now are in many circumstances – households may still have trouble finding the upfront capital to install them. The home improvement loans can address this problem.

Strengthening regulation for consumers

Recommendation six: introduce minimum energy performance standards for properties at the point of sale and when other renovations on the property are carried out

We propose to regulate the energy performance of able to pay homes both prior to the sale of the property and when non-energy home improvement works are being carried out on the property. This would help to drive consumer demand for home energy improvements. Costs for households could be minimised if the government introduced the regulations with a long lead-in time. The upfront cost faced by households would be removed by the availability of the new home improvement loans. The minimum standard of energy performance could be increased over time to ensure government policy objectives were achieved. The government could introduce exemptions for certain households, such as multiple occupancy properties or listed buildings.

First, at the point of sale, households must by law acquire an Energy Performance Certificate (EPC). A minimum EPC rating could be mandated in order for the sale of the home to be permitted. Second, the building code could be amended to mandate builders to improve the home's overall energy performance whenever renovations take place. The costs of the home energy improvements could be capped so they

do not exceed a certain proportion of the overall cost of the building works.

Bolstering the supply chain

Recommendation seven: offer free training and reduced registration fees for small businesses and local tradespeople

We propose that the government provides free training sessions and reduced registration fees for small businesses and local tradespeople. This will help to attract more individual installers into the supply chain, so that local customer networks and higher trust levels can be better utilised in home energy improvements. Together with the previous recommendation, it will also help to maximise the potential of trigger points, such as when households undertake other renovations.

Recommendation eight: introduce a new, single accreditation scheme for all installers of home energy improvements

We propose that the old accreditation frameworks for the Green Deal and Microgeneration Certification Scheme for the installation of decentralised renewables be replaced by a new, single accreditation scheme. This will help to restore consumer confidence in the quality of all home energy improvements and reduce the administrative burden on local tradespeople and small businesses that were previously deterred from getting Green Deal accreditation. Installers will be able to upgrade their accreditation for the different types of home improvement measures they are able to install.

Conclusion

There is an urgent need for many more households in the UK to retrofit their homes, including energy efficiency measures and decentralised renewables. The Green Deal established an innovative financing mechanism and accreditation scheme to increase the take-up of home energy improvements. But the policy failed to drive the necessary

demand. The proposals in this report will address the main reasons for low take-up, by stimulating the market for home energy improvements in a way which is cost-effective for government.

Chapter 1: **Introduction**

Bright Blue's *Green conservatism* project was established to develop distinctive centre-right policies on energy, the natural environment, and international development linked to sustainability. Among the project's stated aims are advocating cost-effective, market-based solutions to climate change, harnessing technological innovation and entrepreneurship to solve environmental problems, and encouraging sustainable, long-term growth. Incentivising 'home energy improvements', which is the focus of this report, is vital to achieving these key aims. Following the failure of the Green Deal, there is now a policy vacuum. New policies from government are urgently required to encourage further progress in installing home energy improvements.

What are 'home energy improvements'?

For the purposes of this report, 'home energy improvements' refer to measures that make homes consume both less and greener energy. It encompasses both reducing energy demand and decarbonising the remaining energy supply.

On the demand side, home energy improvements include energy efficiency measures, energy efficient appliances, and energy saving behaviour.

The efficiency of household appliances, such as toasters or hoovers, can be straightforwardly tackled with regulation of product standards, and so will not be covered by this report. Similarly, there are policies in place to encourage energy saving behaviour, most notably the national rollout of

smart meters, which is set out in greater detail in Box 1.1.

Box 1.1. Creating a smart energy system in homes

A 'smart energy system' in homes gives households more information and control over their energy consumption, enabling them to shift their energy use to times of lower demand and therefore cheaper tariffs. A domestic smart energy system is underpinned by smart meters, and includes a range of smart appliances and smart heating controls.

Smart meters provide customers and their energy suppliers with near real-time information on a household's energy consumption. The Government has mandated that every household in the UK be offered a smart meter by 2020 by their energy supplier. This will require the installation of up to 53 million appliances in people's homes over the next four years.[1]

By increasing the information available to households, smart meters raise awareness of energy consumption, encouraging homeowners to reduce their energy demand. Smart meters also enable energy companies to make savings by ending the practice of site visits and reducing the volume of consumer enquiries. These savings are passed on to consumers in their energy bills.

Smart appliances, such as washing machines, refrigerators, and dishwashers, are operated using an online remote control. They can be switched off or turned down at times of high demand, reducing stress on the electricity grid and potentially saving money for the consumer.

Smart heating controls also operate using an online remote control and are connected to the home's smart meter. They have

1. Department for Energy and Climate Change, "Smart metering implementation programme", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/245736/smart_meters_domestic_leaflet.pdf (2013), 2.

the same function as a thermostat, enabling greater control over the temperature inside the home.

This report examines how energy efficiency measures can be encouraged. We will focus in detail on the most common energy efficiency measures: loft insulation, solid wall insulation, cavity wall insulation, and double glazing in windows. Loft insulation consists of a layer of insulating material applied inside a home's loft to stop heat escaping through the roof. Homes with a single wall can have solid wall insulation added to the outside or inside of the property. Homes with two walls and a gap in-between can have cavity wall insulation installed by injecting insulation material into the gap. Double glazed windows can be installed in a property, which consist of two separate sheets of glass to trap heat.

There are also a number of other minor energy efficiency measures that this report will not discuss in detail, but which can also contribute to reducing a household's energy consumption. These include:[2]

- **Draught proofing** consists of pieces of specialist material that block openings in the home, such as gaps around windows or doors, to stop heat being lost.
- **High-performance external doors** can improve a home's thermal efficiency by stopping heat leaking out of doors.
- **Condensing gas boilers** can be installed to replace older non-condensing gas boilers to prevent heat being wasted.
- **Energy efficient lighting systems** can replace some older fittings, which are only compatible with incandescent lamps, with fittings that accept low energy lamps to improve efficiency.
- **Under floor insulation** consists of adding insulation material to external, suspended or solid floors, so that the property retains

2. Department for Energy and Climate Change, "Illustrative savings for Green Deal improvement measures", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437645/Illustrative_savings_for_Green_Deal_improvement_measures.pdf (2015).

more heat.

- **Hot water cylinder insulation** adds a layer of insulation to the outside of the cylinder, where the water heated by the home's boiler is stored, to stop heat loss.
- **Fan-assisted storage heating** can replace existing storage heaters for space heating to reduce energy consumption.

On the supply side, home energy improvements consist of decentralised renewable heating technologies and decentralised renewable electricity technologies, which we collectively term decentralised renewables.

The decentralised renewables that we will analyse in this report are: heat pumps, biomass boilers, and solar thermal panels (heat technologies), solar PV and battery storage (electricity technologies). Heat pumps use electricity to remove heat from outside, usually from the air or the ground. Biomass boilers burn wood pellets or specially-grown crops to produce heat. Solar thermal panels heat water using warmth from the sun. Solar PV, normally placed on roofs, create electricity using the sun's energy. Batteries store in chemicals surplus electricity generated by solar PV, and deploy the energy when there is demand.

The homes this report will focus on

This report will focus on energy improvements in homes, or the domestic sector. Separate policies are required to drive more energy improvements for businesses (the non-domestic sector).

Within the domestic sector, there are three different kinds of households: the private rented sector, social housing, and owner occupiers. Of these, owner occupiers are by far the largest group, representing around 64% of households in England.[3] Properties with an

3. Department for Communities and Local Government, "English housing survey: headline report 2014-15", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/501065/EHS_Headline_report_2014-15.pdf (2016).

owner occupier have the lowest average energy efficiency rating.[4] As this sector comprises the majority of homes and has some of the worst energy consumption, it is the focus of our report.

Owner occupiers can be sub-divided into the fuel poor and the 'able to pay'. We recognise that there is a group of people that are not officially fuel poor but nonetheless struggle to pay their bills. For the sake of this report, however, we include these people within the 'able to pay' sector. This report will focus on the 'able to pay' sector, which make up 92% of owner-occupiers in England.[5] This group represents 13.2 million properties in total, or 58.5% of all English households. The Government has a separate policy to help the fuel poor, the Energy Company Obligation (ECO), which is detailed in Box 1.2.

Box 1.2. Helping the fuel poor through the Energy Company Obligation (ECO)

This policy aims to deliver the Government's commitment to improve the energy efficiency of one million homes across this Parliament and to reduce fuel poverty.

Supplier obligations, set by government, give energy companies targets of carbon savings they have to make from the emissions of the homes of their customers. The government also sets criteria about which homes are eligible for energy efficiency measures and what measures can be installed. Energy companies then pass on the costs of this scheme to consumers via their utility bills.

Previously, ECO had been focused jointly on reducing fuel poverty, improving energy efficiency of properties in deprived rural areas, and delivering more expensive energy efficiency measures across all households.

4. Ibid., 35.
5. Department for Energy and Climate Change, "Fuel poverty: detailed tables 2013", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437629/Detailed_tables_2015.xls (2015).

The Government recently released proposals for consultation on the next version of the ECO. The new scheme will be reoriented towards alleviating fuel poverty.[6] There are currently around 2.4 million people living in fuel poverty in the UK.[7] The reforms are intended to reduce the costs of the scheme, and to ensure that households that are able to pay for their own measures are not given subsidies.

Why we should incentivise home energy improvements

There are both private and public benefits to home energy improvements which justify action from government to incentivise them.[8]

Private benefits

First, households can take greater personal control over their energy by reducing their consumption and producing their own energy.[9] Consumer research shows that just under two thirds of people do not think there is anything they can personally do about high fuel bills.[10] Carrying out home energy improvements, however, could significantly reduce, or at least change, the role of big energy companies that seem to be untrusted by consumers.[11] It would also protect households from big changes or shocks in wholesale energy prices.

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6. Department for Energy and Climate Change, "ECO: Help to heat", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/531964/ECO_Help_to_Heat_Consultation_Document_for_publication.pdf (2016).
7. Department for Energy and Climate Change, "Annual fuel poverty statistics report, 2015", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/468011/Fuel_Poverty_Report_2015.pdf (2015), 17.
8. For an extensive list of public and private benefits of energy efficiency measures, see Jim Lazar and Ken Colburn, "Recognising the full value of energy efficiency", http://www.raponline.org/wp-content/uploads/2016/05/rap-lazarcolburn-layercakepaper-2013-sept-9.pdf (2013).
9. E3G and The Fabian Society, "Taking back control", https://www.e3g.org/docs/E3G-Fabians-Taking_Back_Control-final.pdf (2015), 12.
10. Annex, Behaviour Change, 1.
11. A recent Department for Energy and Climate Change attitude survey found that almost 40% of people do not trust their energy supplier to give them a good deal; see Department for Energy and Climate Change, "Public attitudes tracker – wave 17", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/519488/PAT_Wave_17_Summary_of_key_findings.pdf (2016), 6.

Second, improving domestic energy use can stop waste heat escaping from properties, making homes warmer and thus healthier. The Marmot Review, which examined ways to reduce health inequalities in England, found that countries which have more energy efficient housing have fewer excess winter deaths, and that excess winter deaths are almost three times higher in the coldest quarter of housing than in the warmest quarter.[12] The study also found that there are different health impacts for different demographics living in cold homes. Elderly people are more vulnerable to pulmonary and respiratory disease. Young people are more likely to experience mental health issues. Adults are more likely to have slower recovery from illness and to contract minor ailments like colds or coughs.

Third, home energy improvements will lower consumer bills in the long-term. Energy efficiency measures reduce the amount of energy required to heat a property, thereby lowering bills. Once the cost of installing the measures has been paid off in the short-to-medium-term, energy bills are permanently reduced. Likewise, there are long-term benefits to consumer bills of installing decentralised renewables. For instance, solar PV generate electricity with no marginal cost. So, once a solar panel has been installed and the product paid for, it generates electricity for free. This displaces electricity that would otherwise have been purchased from the grid, reducing energy bills.

Finally, home energy improvements, like other household renovations, increase the value of a property. Research by the Department for Energy and Climate Change (Department for Energy and Climate Change) found that a house which improves its rating on an Energy Performance Certificate (EPC) is likely to have a higher value than when it had a

12. Marmot Review, "The health impacts of cold homes and fuel poverty", http://www.instituteofhealthequity.org/projects/the-health-impacts-of-cold-homes-and-fuel-poverty/the-health-impacts-of-cold-homes-and-fuel-poverty-full-report.pdf (2011), 26.

lower rating.[13] Energy Performance Certificates give households an energy efficiency rating from A (most efficient) to G (least efficient). On average, a property with an A rating on the EPC sells for 14% more than an equivalent property with a G rating on the EPC.

Public benefits

First, a greater number of home energy improvements will reduce the UK's carbon emissions and help mitigate climate change. The Climate Change Act 2008 requires the UK to reduce its greenhouse gas emissions by 80% on 1990 levels by 2050. Residential buildings make up 22% of the UK's total greenhouse gas emissions.[14]

The Committee on Climate Change has advised that meeting the 2050 target cost-effectively will require much faster progress on improving energy efficiency and decarbonising heat in homes.[15] Their most recent report states that progress on both of these decarbonisation options is currently stagnating.[16] The previous Coalition Government stated in its Carbon Plan that by 2050 all buildings will need to have emissions close to zero.[17] Home energy improvements are better than other decarbonisation policies for the natural environment, because they reduce the need to build new low-carbon generation, such as new nuclear power stations or onshore wind farms, which can harm eco-

13. Department for Energy and Climate Change, "An investigation of the effect of EPC ratings on house prices", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207196/20130613_-_Hedonic_Pricing_study_-_Department for Energy and Climate Change_template__2_.pdf (2013), 18.
14. This figure includes residential CO2 emissions, residential non-CO2 emissions, and the residential sector's share of power emissions. Committee on Climate Change, "Sectoral scenarios for the fifth carbon budget: technical report", https://documents.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf (2015), 60.
15. Ibid., 58.
16. Committee on Climate Change, "Meeting carbon budgets – 2016 progress report to Parliament", https://documents.theccc.org.uk/wp-content/uploads/2016/06/2016-CCC-Progress-Report.pdf (2016), 83.
17. Department for Energy and Climate Change, "The carbon plan: delivering our low carbon future", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47613/3702-the-carbon-plan-delivering-our-low-carbon-future.pdf (2011), 5.

systems and wildlife.[18]

Second, home energy improvements make our energy supply more secure, by reducing reliance on fossil fuel imports and lowering demand for energy at peak times. Energy efficiency measures and decentralised renewables have the potential to reduce our dependence on imported natural gas, which constituted 62% of all the natural gas consumed in the UK in 2015.[19] This would protect households from international price spikes and any geopolitical events that cause the supply of energy to be restricted.

It has been forecast that raising all homes to a band C rating on an Energy Performance Certificate (EPC) would reduce gas imports by 26% by 2030.[20] More energy efficient homes reduce energy consumption in cold winter months when energy demand is at its peak, taking pressure off the energy system. Energy improvements, if they are part of a smart energy system as described in Box 1.1, can enable homes to play a role in balancing the electricity grid.[21] This can help to overcome the problem of intermittent renewable electricity generation.

Third, increased take-up of home energy improvements would increase employment and economic activity in the UK. The sector of the UK low-carbon economy which creates the highest number of jobs is energy efficiency, employing 155,000 people in 2014.[22] It is estimated that the economic impact of raising all homes to a band C on the EPC would be the creation of 108,000 net jobs per annum between 2020 and

18. RSPB, "The RSPB's 2050 energy vision: meeting the UK's climate targets in harmony with nature", http://www.rspb.org.uk/Images/energy_vision_summary_report_tcm9-419580.pdf (2016), 24.
19. Department for Energy and Climate Change, "UK energy statistics, 2015 & Q4 2015", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/513244/Press_Notice_March_2016.pdf (2016), 8.
20. Verco and Cambridge Econometrics, "Building the future", http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf (2014), 29.
21. Maarten De Groote and Mariangiola Fabbri, "Smart buildings in a decarbonised energy system", http://bpie.eu/wp-content/uploads/2016/06/Broch-10-principles_160624_v4c.pdf (2016), 4.
22. Office for National Statistics, "Low carbon and renewable energy economy, final estimates: 2014", https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2014#estimates-by-uk-country (2016).

2030, and an increase in relative GDP of 0.6% by 2030.[23]

The economic benefits of incentivising home energy improvements should be viewed in the same way as infrastructure investment, as they comfortably meet government criteria.[24] Accelerating productivity investment is required to stimulate the UK economy following the vote to leave the European Union.[25] Incentivising home energy improvements, therefore, would spur growth today, and increase the UK's long-term growth potential.[26]

The Green Deal

The previous policy to incentivise home energy improvements in the able to pay domestic sector, the Green Deal, failed. Launched in 2013, it was set up so that consumers could pay for home energy improvements through the savings on their energy bills. The energy efficiency measures and decentralised renewables were funded by a loan, with repayments added to fuel bills.

The scheme was closed in mid-2015, with just over 15,000 Green Deal finance plans in operation.[27] The former Minister for Energy and Climate Change had envisaged 14 million homes would be improved by 2020 and a further 12 million by 2030 under the scheme.[28] Although the legislation for the scheme remains in place, government funding

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23. Verco and Cambridge Econometrics, "Building the future" Separate analysis by Frontier Economics suggests that there would be £8.7 billion of net economic benefits to a major energy efficiency infrastructure programme; see Frontier Economics, "Energy efficiency: an infrastructure priority", http://www.frontier-economics.com/documents/2015/09/energy-efficiency-infrastructure-priority.pdf (2015), 13.
24. For example, Frontier Economics, "Energy efficiency: an infrastructure priority"; Ada Amon and Ingrid Holmes, "Energy efficiency as infrastructure: leaping the investment gap", https://www.e3g.org/docs/E3G_Energy_Efficiency_as_Infrastructure.pdf (2016).
25. Ben Caldecott, "Accelerating productivity investment", *BusinessGreen*, July 20, 2016.
26. Ben Caldecott, "Green and responsible conservatism", http://www.brightblue.org.uk/images/greenandresponsible.pdf (2015), 22-26.
27. Department for Energy and Climate Change, "Green Deal Finance Company funding to end", https://www.gov.uk/government/news/green-deal-finance-company-funding-to-end (2015); Department for Energy and Climate Change, "Green Deal and Energy Company Obligation (ECO): headline statistics (November 2015)", https://www.gov.uk/government/statistics/green-deal-and-energy-company-obligation-eco-headline-statistics-november-2015 (2015).
28. Greg Barker, Green Deal and Big Society event, 20 June 2011, https://www.gov.uk/government/speeches/greg-barker-speech-green-deal-and-big-society-event.

has ended for the Green Deal Finance Company, which provided the finance to Green Deal providers.

There is currently no active scheme for the able to pay sector. The Government has indicated that it will bring forward proposals on a successor later this year.[29] This report outlines what the attributes of this successor should be.

Government urgently needs to improve how energy is consumed in UK homes. But it's not enough simply to build new homes with better energy consumption. At least 80% of the housing stock that will be standing in 2050, by when the UK's greenhouse gas emissions must have been reduced by 80%, has already been built.[30] A substantial portion of the existing housing stock is therefore going to have to be upgraded if key government objectives are to be met, such as decarbonising our energy use and guaranteeing energy security.

As we will show in more detail in Chapter Three, significant progress has now been made on installing cheaper energy efficiency measures, such as loft insulation and cavity wall insulation. 'Deep retrofits' are now required to make further progress. Deep retrofits are a building method that upgrades the energy consumption of existing homes by installing multiple energy efficiency measures and decentralised renewables. This is in contrast to single home energy improvement measures, which are installed in a piecemeal fashion.

Focus of the report

In this report, we explore the trends in two important forms of home energy improvements: energy efficiency measures and decentralised renewables. We diagnose the features of the Green Deal and propose new policies to encourage home energy improvements, especially deep

29. House of Commons Energy and Climate Change Committee, "Oral evidence: home energy efficiency and demand reduction enquiry", http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/energy-and-climate-change-committee/home-energy-efficiency-and-demand-reduction/oral/27049.html (2016), Q255.
30. UK Green Building Council, "Low carbon existing homes", http://www.ukgbc.org/sites/default/files/Low%2520carbon%2520Existing%2520homes.pdf (2008), 1.

retrofits, in the able to pay sector.

The report will seek to answer the following research questions:

1. What are home energy improvements, the advantages and disadvantages of different measures, and the recent trends in their deployment?
2. What are the main experiences and policy lessons from the Green Deal?
3. How can the government encourage more home energy improvements, in particular deep retrofits?

The report is structured as follows:

- **Chapter Two** describes the methodology employed, including an extensive literature review, stakeholder consultation, policy roundtable discussions, and a call for written evidence.
- **Chapter Three** describes the main home improvement measures, analyses their benefits and disadvantages, and the current trends in their deployment.
- **Chapter Four** outlines the experiences and policy lessons of the Green Deal, focusing on the finance mechanism, the communication of the scheme, the consumer experience, and the supply chain.
- **Chapter Five** makes a number of policy recommendations for how the government could introduce a new scheme to incentivise more home energy improvements in the able to pay sector.

Chapter 2: **Methodology**

This report seeks to examine the trends, and the advantages and disadvantages, of the principal options for installing energy efficiency measures and decentralised renewables in people's homes. It analyses why the Green Deal failed and what the main policy lessons were. It then goes on to outline new policies to devise a successor to the Green Deal and increase home energy improvements, especially deep retrofits.

This report focuses on two forms of home energy improvements: first, energy efficiency measures such as loft insulation, solid wall insulation, cavity wall insulation, and double glazing; second, decentralised renewables, for both heat and electricity.

Excluded from this report are considerations of how to incentivise energy improvements in the non-domestic, social housing, and private rented sectors. Instead, we will focus on the able to pay sector among owner occupiers. This is because this comprises the largest group of properties. It consists of 13.2 million households, which makes up 58.5% of the total number of properties. Without significant improvements in the energy consumption of this sector, key government targets on decarbonisation and security of supply will not be met.

Research techniques

We employed four research techniques in this project:

- **Literature review.** We conducted an extensive literature review of the main UK and international evidence. We looked at relevant

academic journals, think tank reports, publications from industry groups and trade bodies, and government studies and datasets.

- **Stakeholder consultation.** We conducted a number of interviews with independent experts, government officials, and industry practitioners.
- **Policy roundtable discussions**. We hosted an invite-only roundtable discussion under the Chatham House rule in May 2016 with leading decision makers and experts. We also held a meeting of the *Green conservatism* advisory board in June 2016 to discuss home energy improvements with leading centre-right politicians and opinion formers.
- **Call for written evidence.** We put out a call for written evidence for our home energy improvement project. We received 19 submissions from a range of organisations with an interest in the Green Deal and home energy improvements. We have published the submissions we received in the annex of this report.

Chapter 3: Trends in home energy improvements

As argued in Chapter One, it is essential that government incentivise more home energy improvements – specifically, energy efficiency measures and decentralised renewables – for various private and public benefits. This chapter describes in greater detail the different energy efficiency measures and decentralised renewables which are available, their benefits and disadvantages, and recent trends in their usage.

Energy efficiency measures

Energy efficiency measures are demand-side responses to improving home energy usage. They reduce a household's energy consumption while maintaining the ambient temperature of the home. They are changes to the physical fabric of the building which prevent heat being wasted. There are four main kinds of energy efficiency measures: solid wall insulation, cavity wall insulation, loft insulation, and double glazing. This section will describe each of these measures, and the recent trends.

Solid wall insulation

Solid wall insulation is the application of insulation material, such as mineral wool or foam, to a solid wall structure to prevent heat escaping the building. The insulation can be fixed either to the inside or the outside of the wall. The oldest properties, built prior to the 1920s, tend to have single, solid walls.[31] It is estimated that solid wall properties make up

31. Energy Saving Trust, "Home insulation: solid wall", http://www.energysavingtrust.org.uk/home-insulation/solid-wall.

27% of the UK housing stock.[32]

As shown in Chart 3.1, solid wall insulation has the greatest potential to save households money, reducing energy bills for a semi-detached house by an average of £331 per year.

However, as indicated by Chart 3.2, it is the most expensive energy efficiency measure, costing between £4,000 and £14,000 for an average semi-detached property.

Cavity wall insulation

Cavity wall insulation is the insertion of insulation material, such as mineral wool or foam, into the gap between two walls to trap heat.[33] A cavity wall consists of two layers of material with a gap or cavity in between. 73% of the UK's housing stock has cavity walls.[34]

As Chart 3.1 indicates, cavity wall insulation can save a typical semi-detached property £165 on their annual energy bills. This is a considerably lower saving than is possible with solid wall insulation, but higher than the other measures.

Chart 3.2 demonstrates that cavity wall insulation is one of the cheapest energy efficiency measures, with an upfront cost of between £500 and £1,500.

Loft insulation

Loft insulation is the laying of insulation material, such as mineral wool or foam, on the floor of a property's loft to stop heat escaping through the roof.[35] Some properties, however, have lofts that are not suitable for insulation, and some properties do not have lofts. This group, ineligible

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32. Element Energy and Energy Saving Trust, "Review of potential for carbon savings from residential energy efficiency", https://www.theccc.org.uk/wp-content/uploads/2013/12/Review-of-potential-for-carbon-savings-from-residential-energy-efficiency-Final-report-A-160114.pdf (2013), 11.
33. Energy Saving Trust, "Home insulation: cavity wall", http://www.energysavingtrust.org.uk/home-insulation/cavity-wall.
34. Element Energy and Energy Saving Trust, "Review of potential for carbon savings from residential energy efficiency", 11.
35. Energy Saving Trust, "Home insulation: roof and loft", http://www.energysavingtrust.org.uk/home-insulation/roof-and-loft.

for loft insulation, represents around 15% of the UK housing stock.[36]

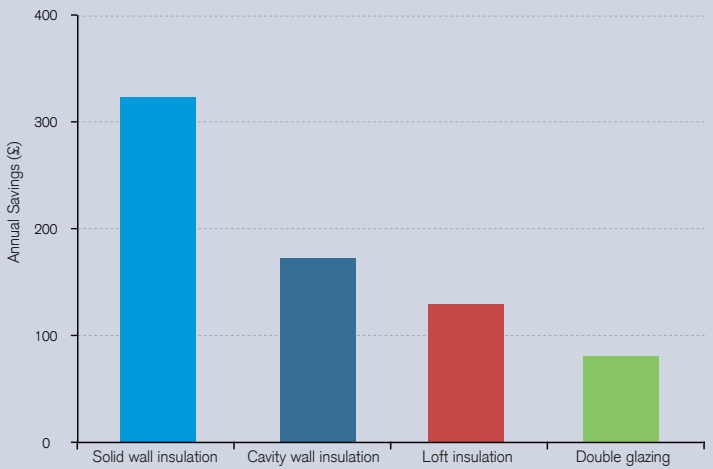
As Chart 3.1 shows, a typical household can save approximately £121 per year on their household bills by installing loft insulation, giving it the third ranked cost saving potential of the energy efficiency measures we are examining.

It is the cheapest energy efficiency measure, costing between £100 and £350 to install (see Chart 3.2).

Double glazing

Double glazed windows consist of two sheets of glass, separated by a gap to trap heat.[37]

Chart 3.1. Annual energy bill savings from different energy efficiency measures for typical semi-detached properties



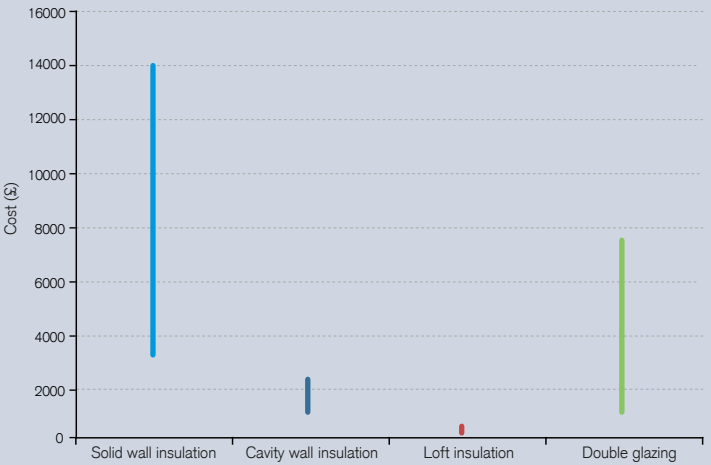
Source: DECC, "Illustrative savings for Green Deal improvement measures", (2015).

36. Element Energy and Energy Saving Trust, "Review of potential for carbon savings from residential energy efficiency", 23.
37. Energy Saving Trust, "Energy efficient windows", http://www.energysavingtrust.org.uk/home-energy-efficiency/energy-efficient-windows.

Chart 3.1 shows that semi-detached households can save on average £71 per year on their energy bills if they install double glazing. This is the smallest energy saving of the measures we have examined.

Installation of double glazing would have an upfront cost of between £3,300 and £6,500, as indicated in Chart 3.2. This is the second most expensive energy efficiency measure we discuss.

Chart 3.2. Average cost ranges for energy efficiency measures



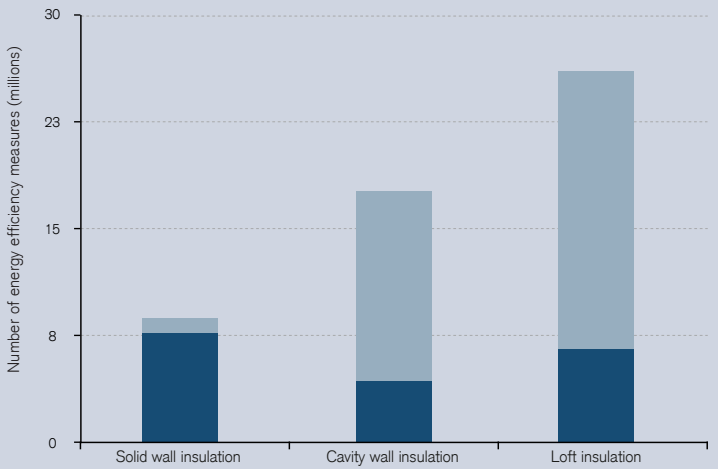
Source: DECC, "Illustrative savings for Green Deal improvement measures", (2015).

Trends in energy efficiency measures

Chart 3.3 shows how levels of solid wall insulation are currently very low, with just 340,000 solid wall insulated and 7.5 million solid walls without any insulation. As shown in Chart 3.3, many cavity walls have already been insulated, with 14.3 million cavity walls insulated and just 4.7 million remaining to be insulated. Chart 3.3 shows that 16.8 million lofts have now been insulated, with 7 million lofts still requiring additional insulation. The data on the number of double glazing

installations has not been collected in the same way as for solid wall, cavity wall and loft insulation. However, the most recent figures from 2014 show that 80.8% of English households have had double glazing installed.[38] This shows that progress in installing this energy efficiency measure in the housing stock is well advanced.

Chart 3.3. Completed and potential energy efficiency measures under the Green Deal, up to June 2015



Source: DECC, "Green Deal, Energy Company Obligation (ECO) and insulation levels in Great Britain, detailed report: to June 2015" (2015).

Energy efficiency measures have the potential to save households significant amounts of money on their energy bills. The upfront cost for these measures varies, but the initial capital outlay can often be recouped through accumulated bill savings. For instance, the typical cost of cavity wall insulation could be paid for by bill savings after six years and loft

38. Department for Communities and Local Government, "English housing survey 2014 to 2015: headline report".

insulation after two years.[39] While many properties have now had cavity wall insulation, loft insulation and double glazing installed, further progress on solid wall insulation, the most expensive energy efficiency measure, is essential to reduce domestic energy consumption. It has been estimated that potential domestic energy efficiency measures could save 49 metric tonnes of UK carbon emissions each year, which is around 10% of the current emissions total.[40]

Decentralised renewables

'Decentralised renewables' refers to small-scale energy generators, installed in individuals' homes, that operate using renewable sources of energy. These are used instead of conventional sources of energy generation, such as condensing gas boilers for heating or gas-fired power stations for electricity. Renewable sources of energy include wind, sunlight, ambient heat from the air, and geothermal heat. 'Decentralised' refers to the fact that they are local generating systems, not operated by national energy companies. As discussed in Chapter One, decentralised renewables include both renewable heat technologies and renewable electricity generation in homes.

Renewable heat

There are three main renewable heat technologies that can be deployed by individuals in their homes in place of a gas boiler: ground-source and air-source heat pumps, biomass boilers, and solar thermal panels. Heating technologies are used both to heat space and water.

39. Department for Energy and Climate Change, "Illustrative savings for Green Deal improvement measures".
40. Element Energy and Energy Saving Trust, "Review of potential for carbon savings from residential energy efficiency", 4. Committee on Climate Change, "Meeting carbon budgets – 2016 report to Parliament", 11.

Box 3.1. The potential of district heat networks

A key policy in the Government's strategy for decarbonising heat is increasing the number of district heat networks. They are an alternative distribution mechanism for heating from installing heating generating systems in individuals' homes, such as gas boilers. They are a system of insulated pipes that carry heat from a centralised generator to individual homes. The fuel can come from a range of sources, including waste heat from power and industry sectors, energy from waste plants, and river-source heat pumps.[41] District heat networks are delivered and financed by energy companies, government, housing associations, and local authorities. Individual homeowners do not install them themselves, and so they are not discussed in detail in our report.

Heat networks are compatible with different heating technologies. There are currently 2,000 heat networks in the UK, supplying heat to around 21,000 homes.[42] They could play a significant role in the future heating of the domestic sector, in particular because of their potential to deliver low-carbon heat at scale. The Government has allocated £300 million to heat networks over the course of the Parliament,[43] and has produced a strategy to generate £2 billion of capital investment in these schemes.[44]

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41. Frontier Economics and Imperial College London, "Research on district heating and local approaches to heat decarbonisation", https://documents.theccc.org.uk/wp-content/uploads/2015/11/Element-Energy-for-CCC-Research-on-district-heating-and-local-approaches-to-heat-decarbonisation.pdf (2015), 9.
42. Department for Energy and Climate Change, "Heat networks delivery unit", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/513884/HNDU_overview_round6_April2016.pdf (2016), 4.
43. Her Majesty's Treasury, "Spending Review and Autumn Statement 2015", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/479749/52229_Blue_Book_PU1865_Web_Accessible.pdf (2015), 96.
44. Department for Energy and Climate Change, "Investing in the UK's heat infrastructure: heat networks", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/477898/Heat_Networks_Invest_Guide_Nov2015.pdf (2016).

Heat pumps

There are two main kinds of heat pumps, ground-source and air-source. They both work by extracting freely-available, naturally occurring heat, from the ground and the air respectively, using electricity. Ground-source heat pumps require an outdoor space, and so their take-up potential is limited to houses with sizeable gardens.[45] Air-source heat pumps have fewer space constraints.

One major advantage of heat pumps is that they use existing electricity infrastructure. By electrifying the heating sector, the UK would be following the same policy approach to decarbonisation as that being taken in the transport sector, where electric vehicles use existing infrastructure.[46] Once operational, heat pumps also reduce fuel costs for consumers and offer significant carbon savings per unit of heat consumed.[47] But there are two main barriers to greater uptake of heat pumps: high upfront cost and hassle for consumers.

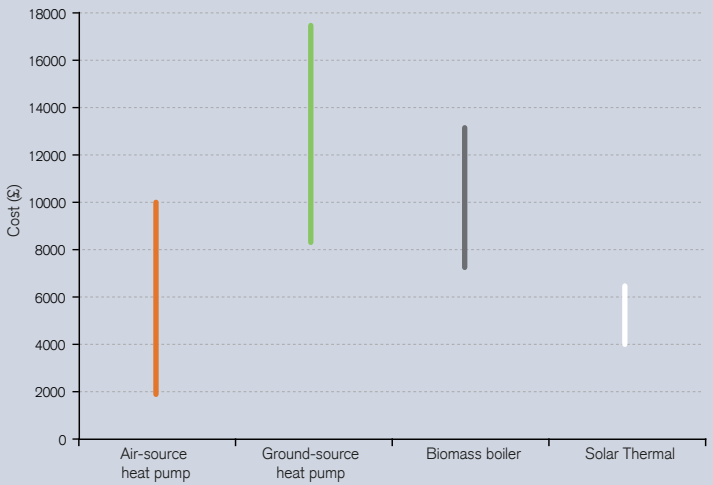
First, heat pumps have a high upfront cost. Chart 3.4 shows the relatively high costs of heat pumps compared to non-renewable gas-fired condensing boilers, which cost between £2,200 and £3,000.[48] Ground-source heat pumps, costing between £9,000 and £17,000, have higher capital costs than air-source heat pumps, which cost between £3,000 and £10,000. This is because of the additional work involved in the outdoor excavations.[49]

Second, installing heat pumps is a major hassle for households, as they

45. Carbon Connect, "Pathways for heat: low carbon heat for buildings", http://www.policyconnect.org.uk/cc/sites/site_cc/files/carbonconnect_pathwaysforheat_webcopy.pdf (2016), 41.
46. This assumes progressive decarbonisation of the electricity sector.
47. UCL Energy Institute, "Analysis of data from heat pumps installed via the Renewable Heat Premium Payment (RHPP) scheme to the Department of Energy and Climate Change (Department for Energy and Climate Change)", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/499194/Department for Energy and Climate Change_RHPP_160112_Detailed_analysis_report.pdf (2016), 16-19.
48. Department for Energy and Climate Change, "Illustrative savings for Green Deal improvement measures".
49. Carbon Connect, "Pathways for heat: low carbon heat for buildings", 47.

can require major renovations to the building's fabric.[50] For example, because heat pumps produce heating at a lower temperature than conventional heating systems, such as gas boilers, they often require new heat emitters, such as radiators, to be installed.[51] For the same reason, heat pumps also require homes to be highly energy efficient, as they are insufficiently powerful to compensate for heat lost through walls and roofs. In some cases, this necessitates the installation of additional energy efficiency measures, which are outlined earlier in this chapter.

Chart 3.4. Cost range for principal domestic heating technologies (renewable and non-renewable)



Source: DECC, "Illustrative savings for Green Deal improvement measures", (2015).

Biomass boilers

Biomass boilers burn organic fuel ('bioenergy'), such as wood pellets

50. Richard Snape, Peter Boait, and Mark Rylatt, "Will domestic consumers take up the Renewable Heat Incentive? An analysis of the barriers to heat pump adoption using agent-based modelling", *Energy Policy* (2015), 32-38.
51. Annex, Donal Brown (Centre for Innovation and Energy Demand), 3.

and purpose-grown crops, to generate heat. Biomass boilers can be installed effectively in properties that are not connected to the gas grid, because they do not have to compete against condensing gas boilers on cost. Similarly, where the heating demand in a building is too high to be met by a heat pump, biomass boilers can be an effective solution.

The two main barriers to greater uptake are high upfront cost and sustainability of bioenergy.

First, as Chart 3.4 shows, biomass boilers are the second most expensive renewable heat technology, costing between £7,000 and £13,000.

Second, the potential for widespread deployment of biomass boilers is limited by the availability of sustainable bioenergy. If the entire UK heating demand was met using biomass boilers, it would use up 55% of the global supply of wood pellets.[52] Furthermore, Department for Energy and Climate Change has modelled the impact of carbon emissions for a range of different scenarios for bioenergy in 2020.[53] They find that, under some scenarios where demand for bioenergy is high, there are in fact no carbon savings compared to fossil fuels because of land use change and the release of previously stored carbon.

Solar thermal panels

This technology uses energy from the sun to generate heat. As Chart 3.4 demonstrates, solar thermal panels are the lowest cost renewable heat technology. They can operate effectively in a property where another heating solution, such as heat pumps, has been installed.

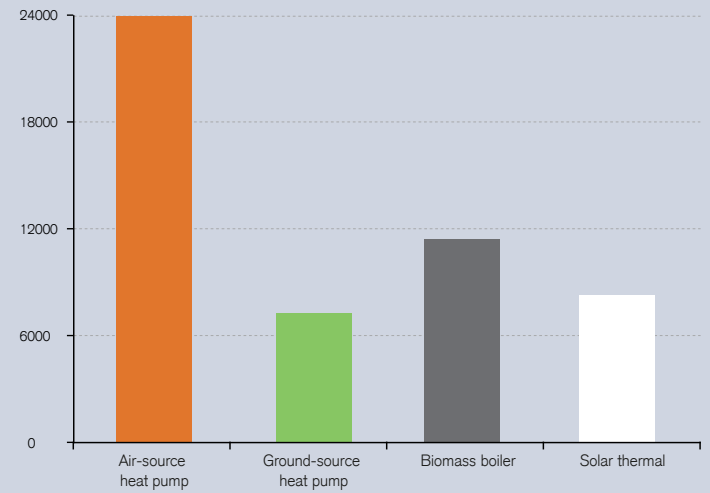
The uptake of solar thermal panels in the future is constrained by the fact that the technology does not reliably generate heat in winter when it is most needed (during cold weather), as the sun often does not shine.

52. Annex, Good Energy, 3.
53. Department for Energy and Climate Change, "Life cycle impacts of biomass electricity in 2020", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf (2014), 18.

Trends in renewable heating

Chart 3.5 shows the total number of accredited installations of renewable heat technologies under the domestic Renewable Heat Incentive (RHI) to date.[54] It shows that air-source heat pumps are the most popular technology, with 22,161 installations, then biomass boilers with 11,612 installations, then solar thermal in third with 7,662 installations, and finally ground-source heat pumps with 7,047 installations.

Chart 3.5. Number of accredited installations under the domestic RHI, by technology, April 2016



Source: DECC, RHI deployment data: April 2016 (2016).

One major barrier to greater deployment of renewable heat technologies is that our existing gas network is a huge sunk cost. Natural

54. The accredited installations under the RHI give a good reflection of the overall levels of historic deployment. Although the domestic RHI only opened in April 2014, previously installed renewable heat appliances were able to apply retrospectively for accreditation. See Department for Energy and Climate Change, "RHI deployment data: April 2016", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/525028/RHI_monthly_official_statistics_tables_30_April_2016.xlsx (2016).

gas provides around 90% of our current heating demand.[55] It provides cheap and abundant fuel to households, and utilises an existing network which companies have invested in and consumers have paid for through their utility bills.[56]

Another important barrier is a lack of awareness of renewable heat technologies and government funded incentives for them. Only 5% claimed to know a lot about the different renewable heat technologies in Department for Energy and Climate Change's recent public attitudes polling. Similarly, just 12% of those surveyed were aware of the RHI, which is described in Box 3.2.[57]

Box 3.2. The Renewable Heat Incentive (RHI)

Introduced in 2014, this scheme pays a fixed tariff to the property owner per unit of renewable heat produced. A number of technologies are eligible, and each receives a different tariff: heat pumps, biomass boilers, and solar thermal. A government review concluded that the availability of this financial incentive was the most important reason why households chose to install renewable heat technologies.[58] The funding for the scheme comes from general taxation.

The Government has recently released a consultation on the future design of the RHI scheme.[59] The effect of the proposed changes will be to focus available support on heat pumps, reduce the tariff for biomass boilers, and remove all support for solar

55. National Grid, "Future energy scenarios: GB gas and electricity transmission", http://fes.nationalgrid.com/fes-document/ (2016), 46.
56. Nick Eyre and Pranab Baruah, "Uncertainties in future energy demand in UK residential heating", *Energy Policy* (2015), 641-653.
57. Department for Energy and Climate Change, "Department for Energy and Climate Change public attitudes tracker – wave 15", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/474170/Wave_15_Summary_of_Key_Findings.pdf (2016), 7.
58. Department for Energy and Climate Change, "Census of owner-occupier applicants to the domestic RHI: waves 1 to 12", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/496390/Domestic_census_waves_1-12.pdf (2016), 3.
59. Department for Energy and Climate Change, "The Renewable Heat Incentive: a reformed and refocused scheme", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505972/The_Renewable_Heat_Incentive_-_A_reformed_and_refocussed_scheme.pdf (2016).

thermal panels. In the 2015 Spending Review, the budget for the scheme was set to rise to £1.15 billion by 2020-21.[60] Although the final spending figure is an increase from £850 million in the 2010 Spending Review, spending on the scheme this year will be just £593 million.[61] The new tariffs for households have not been confirmed yet, as the Government has not published its response to the consultation.

While biomass boilers and solar thermal panels could play some role in future heating systems, the renewable heat technology that will be deployed at scale is likely to be heat pumps. This is especially true now the Government has recalibrated the RHI to incentivise further uptake of this technology.

The Committee on Climate Change found that just 2.5% of the UK's heating demand was met from low-carbon sources in 2014.[62] In order to cost-effectively meet carbon budgets, they forecast that this figure must rise to 8% by 2020, which would require a major increase in take-up over the next few years. Greater deployment is therefore required to develop the technology and its supply chains, and to bring costs down further. The policies proposed in this report, as detailed in Chapter Five, will facilitate retrofits of both energy efficiency measures and decentralised renewables simultaneously.

Renewable electricity

The vast majority of our electricity, such as offshore wind farms, combined cycle gas turbines (CCGTs), and nuclear power stations,

60. Her Majesty's Treasury, "Spending Review and Autumn Statement 2015", 52.
61. Her Majesty's Treasury, "Spending Review 2010", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/203826/Spending_review_2010.pdf (2010), 24. Department for Energy and Climate Change, "Consultation stage impact assessment: the Renewable Heat Incentive: a reformed a refocused scheme" https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505132/Consultation_Stage_Impact_Assessment_-_The_RHI_-_a_reformed_and_refocussed_scheme.pdf (2016), 61.
62. Committee on Climate Change, "Meeting carbon budgets – 2016 progress report to Parliament", 90.

is not currently decentralised, but financed and operated by national energy suppliers. However, the advent of cheap renewables has given homeowners the option to install their own decentralised renewable electricity technologies in their homes.

The principal generation technology for renewable electricity is solar PV, which are discussed below. Battery storage, which can store electricity generated at a time of low demand, and release it when required, is also treated in this section. In addition, there are some uncommon forms of decentralised renewable electricity generation: micro-wind turbines, which use the wind to generate electricity, and micro-hydro, which use energy from water to create electricity.

Solar PV

Solar PV essentially constitute the entirety of decentralised renewable electricity generation in the UK. The panels are typically mounted on the roof of a house, and turn the sun's energy into electricity.

The cost of rooftop mounted solar in 2015 was estimated to be £175/MWh.[63] In 2012, when Department for Energy and Climate Change estimated what the cost of small-scale solar would be, for installations commissioned in 2015, they thought it would be £269/MWh.[64] The consumer magazine *Which?* has found that the upfront cost of installing a solar system for the consumer has fallen from an average of £11,329 in 2011 to £6,750 in 2015.[65] This represents a fall in cost of just over 40% in four years.

Battery storage

Electricity generated by a home's solar PV, for which there is no immediate demand, can be stored in chemicals inside a battery until

63. KPMG, "UK solar beyond subsidy: the transition", http://www.r-e-a.net/upload/uk-solar-beyond-subsidy-the-transition.pdf (2015), 12.
64. Department for Energy and Climate Change, "Electricity generation costs", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65713/6883-electricity-generation-costs.pdf (2012), 23.
65. Which?, "How to buy solar panels", http://www.which.co.uk/energy/creating-an-energy-saving-home/guides/how-to-buy-solar-panels/solar-pv-prices-and-savings/ (2016)

demand exists. There are two main types of battery storage chemicals: lithium-ion and lead acid batteries. Battery storage enables households to consume more of the electricity that they produce themselves, and helps to overcome the intermittency of renewable electricity generation.

Batteries have historically been very expensive and so unaffordable to domestic customers. However, dramatic falls in the price of lithium-ion mean that these batteries will soon be within the scope of household finances. This cost reduction has been driven by significant deployment of lithium-ion in electric vehicles and consumer electronics.[66] Between 1995 and 2011, the price of lithium-ion batteries fell from $3,185/kWh to $320/kWh.[67] Costs are expected to continue to fall by around 12% per annum until 2020, with slower falls thereafter. [68] In the US, the Tesla has just launched its new domestic battery system, Powerwall, which costs $3,500.'[69]

Trends in renewable electricity

Recent deployment of small-scale solar PV in the UK has been impressive. There have been 836,152 solar panels installed on households' rooftops, representing a total installed capacity of 2.4 GW (including retrospective accreditations).[70] At the start of 2010, there were just 5,059 such installations with a total capacity of 10 MW. This implies a huge increase in take-up of solar PV in the last six years. Small-scale solar PV now represent around 3% of total UK electricity generation capacity.[71]

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66. National Infrastructure Commission, "Smart power", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf (2016), 37.
67. KMPG, "Development of decentralised energy and storage systems in the UK", http://www.r-e-a.net/upload/rea_storage_report-web_accessible.pdf (2016), 18.
68. Ibid., 20.
69. Steven Morris, "Welsh home installs UK's first Tesla Powerwall storage battery", *The Guardian*, February 5, 2016
70. These figures are based on solar photovoltaic deployment under the FIT scheme with a capacity of 0-4 kWh; see Department for Energy and Climate Change, "Solar photovoltaics deployment" https://www.gov.uk/government/statistics/solar-photovoltaics-deployment (2016).
71. Department for Energy and Climate Change, "Digest of United Kingdom Energy Statistics 2016", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541005/DUKES_2016_FINAL.pdf (2016), 115.

Current levels of domestic battery storage are estimated to be very low.[72] However, a number of storage technologies are thought to be on the verge of commercialisation. For instance, the government recently funded a £1.5 million demonstration project for Moixa's domestic energy storage system, Maslow, which was installed in 250 homes.[73]

Box 3.3. The Feed-in Tariff (FIT)

First introduced in 2010, this scheme pays a fixed tariff per unit of electricity generated from small-scale renewable sources. A tariff is received both for generation of electricity, and for exporting surplus energy to the grid that is not consumed by the household. Solar PV are by far the most commonly supported technology, but small-scale wind turbines, hydroelectric power, and combined heat and power systems are also eligible. The cost of the scheme is added as a levy on consumer energy bills, and is controlled by the government's Levy Control Framework (LCF), which monitors the cumulative impact of government policies on household fuel costs.

In 2015, the Government announced changes to the FIT scheme to reduce the costs to bill payers, including reduced tariffs and degression rates.[74] This was in response to the greater than expected demand for accreditations under the scheme, and the fact that the costs of solar PV have plummeted. Support for new installations accredited under the FIT has now been capped £100 million per year. As a result of the reforms, the government forecasts that the total cost of the scheme

72. Department for Energy and Climate Change, "Towards a smart energy system", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486362/Towards_a_smart_energy_system.pdf (2015), 9.
73. Moixa Technology, "Department for Energy and Climate Change energy storage demonstration", http://www.meetmaslow.com/wp-content/uploads/2015/07/Moixa-Technology-Department for Energy and Climate Change-Project-summary.pdf (2015).
74. Department for Energy and Climate Change, "Review of the Feed-in Tariff scheme", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487300/FITs_Review_Govt__response_Final.pdf (2015), 21.

will be £1.3 billion by the end of the Parliament. [75]

Decentralised renewable electricity has enjoyed significant success in recent years, with good deployment rates and rapidly falling costs of solar PV. Now that there is a resilient supply chain and reduced upfront costs for solar PV, the challenge is to deepen their market penetration and encourage households to couple them with domestic battery storage to optimise the power they produce.

Conclusion

Recent trends in home energy improvements vary between the different energy efficiency measures and decentralised renewables. The cheaper energy efficiency measures, that save the least energy, have been deployed at scale, although there is still significant potential for more installations. However, the market for the more expensive measure, solid wall insulation, which has the greatest energy saving potential, is not yet very developed.

Decentralised renewable heat has had very poor uptake in recent years, whereas the main decentralised renewable electricity source we have examined, solar PV, has performed very well. Dramatic cost reduction in battery storage technologies suggests that renewable electricity technology has great potential to grow. In all cases, however, further development and deployment is required to meet the key policy objectives. The next chapter will analyse why the Government's flagship policy to stimulate this market failed.

75. Department for Energy and Climate Change, "Impact assessment: government response to consultation on a review of the Feed-in Tariff scheme", https://www.gov.uk/government/consultations/consultation-on-a-review-of-the-feed-in-tariff-scheme (2015), 25.

Chapter 4: **Why the Green Deal failed**

The previous chapter showed how progress in retrofitting energy efficiency measures and decentralised renewables – crucial for making households consume less and greener energy – has been slower than required. This is in part down to the failure of policies like the Green Deal that were intended to incentivise more home energy improvements. This chapter will outline in detail the attributes of the Green Deal, the reasons for failure, and the policy lessons that should be learned.

What was the Green Deal?

The Green Deal was launched in 2013 to encourage able to pay households to invest in home energy improvements. At the time of the launch, the then Energy and Climate Change Minister, the Rt Hon Greg Barker MP, described it as "the largest and most ambitious home improvement programme our country has seen since the second world war".[76] He stated that his ambition for the policy was "to improve 14 million homes by 2020 and a further 12 million by 2030."

Passed into law via the Energy Act 2011,[77] the Green Deal legislation established a regulatory framework of advice, accreditation and assurance for the installation of energy efficiency measures and decentralised renewables in people's homes. The legislation also set up

76. Greg Barker MP, Green Deal and Big Society event, 20 June 2011, https://www.gov.uk/government/speeches/greg-barker-speech-green-deal-and-big-society-event.
77. UK Government, "Energy Act 2011", http://www.legislation.gov.uk/ukpga/2011/16/pdfs/ukpga_20110016_en.pdf (2011).

an innovative financial mechanism, with which households paid for home energy improvements with a loan. The repayments for this loan were made through energy bills.

The Energy Act 2011 amended consumer credit legislation, so that special customer protections were added to the Green Deal loan. This allowed these loans to be attached to properties, rather than to the individual that took out the loan. These consumer protection amendments enabled some individuals to qualify for Green Deal credit who were unable to gain access to conventional sources of finance, such as those with less good credit ratings. It has been estimated that Green Deal finance was available to 83% of the population, whereas normal consumer finance is available for roughly half the population.[78] The 'Golden Rule' was also established, which prevented loans being made for which the repayments would be greater than the estimated savings on energy bills.

Consumers interested in installing home energy improvements could begin the Green Deal process by contacting an accredited assessor to receive an assessment. A certified Green Deal assessor could be an organisation or a sole trader, of which there were 308 and 4,035 respectively by the end of the scheme.[79] They can work independently, contract with, or be part of a Green Deal provider organisation. The assessor would visit a potential customer's home, audit their home's energy use, and inform them which measures could be installed under the Green Deal scheme and the potential energy savings of the measures. This information was put into a Green Deal advice report. Consumers had to pay upfront the cost of this Green Deal assessment, which was on average £136.[80]

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78. UK Green Building Council, "Green Deal Finance", http://www.ukgbc.org/sites/default/files/140120%2520Green%2520Deal%2520Finance%2520Task%2520Group%2520-%2520Report%2520FINAL.pdf (2014), 8.
79. Department for Energy and Climate Change, "Green Deal and Energy Company Obligation (ECO): headline statistics (November 2015)".
80. Department for Energy and Climate Change, "Research into the Green Deal and ECO programme supply chain", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/421010/P10_GD_Supply_chain_research.pdf (2014), 53.

If a customer chose to proceed with installing measures and wanted to finance the work using the Green Deal, they then could shop around for a Green Deal provider. There were 176 such providers by the end of the scheme.[81] These were organisations that sell consumers a Green Deal plan to provide the finance for the measures and arrange for an accredited installer to retrofit them. The Green Deal loans were aggregated and refinanced by the Green Deal Finance Company, funded and capitalised jointly by government and a number of private sector companies.

Green Deal providers contracted accredited Green Deal installers to carry out the improvements contained in the Green Deal plan. There were 1,926 Green Deal installers by the end of the scheme.[82]

Repayments for the Green Deal plan were added automatically to consumers' energy bills. Energy companies sent the repayments to the Green Deal provider. The cost of the measures and of the finance were borne entirely by the consumer, without government subsidy.

This step-by-step process for the Green Deal is shown in Figure 4.1.
The financial mechanism underpinning the Green Deal is referred to as 'pay as you save' or 'on-bill financing'. They both refer to the fact that the loan that funds the energy saving measures is repaid via energy bills. There are two principal advantages to this kind of financial product. First, the loans are transferred on the sale of the property. This ensures that whoever is saving money on their energy bills through the installation of these measures also makes the loan repayments for the measures. This feature overcomes the barrier of misaligned incentives, where the person that pays for the measures does not accrue the energy saving benefits. For example, in the owner occupier sector, some householders may intend to move properties in five years' time, and so do not see any financial value in investing in energy saving measures in their current property. Second, there is no upfront cost to Green Deal loans. Home energy improvements, therefore, are not forced to

81. Department for Energy and Climate Change, "Green Deal and Energy Company Obligation (ECO): headline statistics (November 2015)".
82. Ibid.

compete with other household renovations, such as new kitchens or extensions.

Figure 4.1. Green Deal process

Before the Green Deal, home energy improvement schemes in the UK had been funded primarily through supplier obligations.[83] Many different versions of these schemes had been in place since 1994, each with their own distinct energy and carbon saving targets and criteria for meeting the targets. Suppliers attached the costs of delivering the schemes to the bills of all their customers, not just those that benefited. The Green Deal broke with that tradition. It was introduced in part to help unlock more private investment in home energy improvements, by removing financial barriers to individuals funding measures themselves, and therefore to increase the overall number of homes that

83. Jan Rosenow and Nick Eyre, "The Green Deal and the Energy Company Obligation", *Proceedings of the ICE – Energy* (2013), 127-128.

were improved. Department for Energy and Climate Change expected that there would be between £1 billion and £1.3 billion of private investment for the first three years of the scheme, and between £3.2 billion and £4.1 billion by 2022.[84]

The Green Deal and the Energy Company Obligation (ECO)

The Green Deal was designed to operate alongside the Energy Company Obligation (ECO), a supplier obligation to save carbon emissions by improving the energy efficiency of their customers' homes.[85] Between January 2013 and December 2015, ECO cost suppliers £3 billion.[86] This was estimated to add £50 to the average annual consumer bill.[87] The original ECO scheme was reformed in 2013, in response to political pressure over rising energy bills.[88] These changes reduced the cost of the scheme by allowing the carbon saving targets to be met through the use of cheaper measures, such as cavity wall insulation. The Government claimed these reforms saved an average of between £30 and £35 per year on each household bill.[89] The Government has committed to reforming ECO again to focus the scheme on the fuel poor, as described in Box 1.2.

The version of the ECO that operated in conjunction with the Green Deal had three components: to finance expensive energy efficiency measures, such as solid wall insulation, that would not qualify for

84. Department for Energy and Climate Change, Final stage impact assessment for the Green Deal and Energy Company Obligation, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42984/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf (2012), 51.
85. National Audit Office, "Green Deal and Energy Company Obligation", 22.
86. Ibid., 9.
87. Department for Energy and Climate Change, "Energy Company Obligation (ECO) delivery costs", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/260907/eco_delivery_costs.pdf (2013), 4.
88. Department for Energy and Climate Change, "The future of the Energy Company Obligation", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/342178/The_Future_of_the_Energy_Company_Obligation_Government_Response.pdf (2014).
89. Department for Energy and Climate Change, "Government action to help hardworking people with energy bills", https://www.gov.uk/government/news/govt-action-to-help-hardworking-people-with-energy-bills (2013).

Green Deal finance under the Golden Rule; to install energy efficiency measures in deprived rural areas; and to improve the energy efficiency of households in fuel poverty. The Government claimed that the use of some ECO funding for expensive energy efficiency measures in the able to pay sector allowed the supply chain to develop, lowering the cost over time and ultimately bringing them within the scope of the Green Deal's Golden Rule.[90] By mandating that households have a Green Deal assessment prior to being offered energy efficiency improvements under ECO, government also expected that households might fund the cost of some measures using Green Deal finance (up to what was permitted under the Golden Rule) and the remainder with ECO. This was called 'blended finance'.

Box 4.1: Comparing international home energy improvement schemes

The Green Deal was an original scheme, having not been implemented anywhere else in the world. However, governments in other countries have similar schemes to the Green Deal to leverage private investment into home energy improvements, but the structure of these schemes was always different to the UK's Green Deal.

In **Germany**, able to pay households take out loans to fund energy saving improvements in their homes, like under the Green Deal.[91] The principal distinction is that a government-owned investment bank, the KfW, subsidises the interest rates of these loans. The Government funds various schemes, at a total annual cost of €2 billion, for properties renovated to meet the 'KfW Efficiency House'

90. Department for Energy and Climate Change, "What measures does the Green Deal cover", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48088/1734-what-measures-does-the-green-deal-cover.pdf (2011), 13.
91. For a systematic comparison of the German scheme with the Green Deal, see Jan Rosenow et al., "Overcoming the upfront investment barrier – comparing the German CO2 building rehabilitation programme and the British Green Deal", Energy and Environment (2013), 83-103.

standard. [92]

In the **Netherlands,** the 'Energiesprong' initiative uses government-backed loans to housing associations to fund deep retrofits of multiple measures. Housing associations repay these loans by collecting the energy savings from tenants' bills.[93] The use of energy savings to make the loan repayments is similar to the pay as you save financial model of the Green Deal. Like the Green Deal, there is an emphasis on the quality of the improvements. Each retrofit must be completed within 10 days, improve the aesthetics of the home, and reduce the property's net energy consumption to zero.

In some **US** states, 'property-assessed clean energy' (PACE) schemes provide loans from municipal governments to fund retrofits. These loans therefore do not come from specialist organisations like Green Deal providers. These loans are secured against the homeowner's property and are repaid through property taxes, rather than through energy bills.

Green Deal vouchers schemes

The Government tried to increase demand for the Green Deal through two incentive schemes. First, there was the Green Deal Cashback scheme, operating between February 2013 and June 2014. The Government spent a total of £16 million on this scheme, and it subsidised an additional 16,000 home improvement measures.[94] The scheme enabled homeowners with a Green Deal assessment to claim cashback for each measure installed, up to a total of two thirds of the amount you have to pay.[95]

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92. Caroline Kumezko, "Governing for demand management innovations in Germany: politics, policy, and practice", http://projects.exeter.ac.uk/igov/wp-content/uploads/2016/02/CK-Governing-for-Demand-Mangement-Innovations.pdf (2016), 97.
93. Arthur Neslen, "Ikea kitchens help sell insulation to the Dutch – and the UK could be next", *The Guardian,* October 10, 2014
94. National Audit Office, "The Green Deal and the Energy Company Obligation", 24.
95. Department for Energy and Climate Change, "The Green Deal: cashback for energy-saving home improvers", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/294533/Cashback.pdf (2014).

Second, there was the Green Deal Home Improvement Fund. The scheme helped people to install home energy improvements by giving them money back on the cost of the measures. This scheme cost £154 million overall and was released in three separate rounds in June 2014, December 2014, and March 2015.[96] In total, it subsidised an additional 27,000 measures.[97] All households that had had a Green Deal assessment and a quote from an accredited Green Deal installer were eligible. Each round of the scheme was configured differently, with different amounts of cashback on offer and different eligibility criteria for items that could be subsidised. It was so popular that the fund was quickly exhausted whenever a new round was released.[98] The first round of funding was fully allocated within six weeks.[99]

The reality of the Green Deal

Between 2013 and 2015 when the Green Deal was in operation, 15,138 Green Deal plans were sold. In total, these plans financed 20,347 distinct home energy improvements. This was substantially short of the aspiration of 14 million homes improved by 2020 that the then Energy and Climate Change Minister stated on launching the Green Deal.

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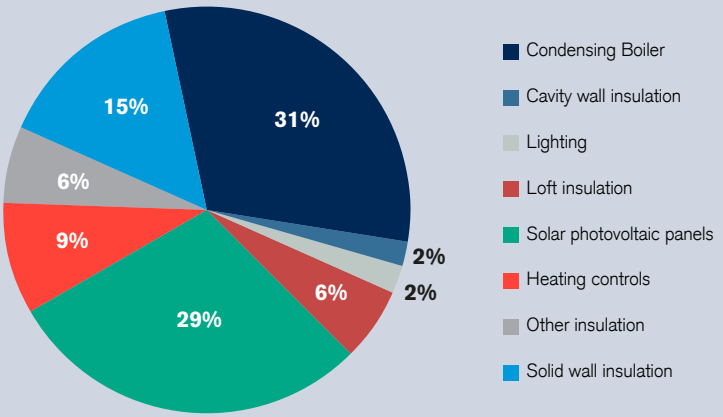
96. Department for Energy and Climate Change, "£7600 to make your home more energy efficient", https://www.gov.uk/government/news/7600-to-make-your-home-more-energy-efficient (2014); Department for Energy and Climate Change, Green Deal home improvement fund details announced, https://www.gov.uk/government/news/green-deal-home-improvement-fund-details-announced (2014); Department for Energy and Climate Change, £70 million for home energy efficiency through the Green Deal Home Improvement Fund Release 3, https://www.gov.uk/government/news/70-million-for-home-energy-efficiency-through-the-green-deal-home-improvement-fund-release-3 (2015).
97. Department for Energy and Climate Change, "Domestic Green Deal and Energy Company Obligation in Great Britain: headline report", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/477288/Headline_Release_-_GD___ECO_in_GB_19_Nov_Final.pdf (2015).
98. Jan Rosenow and Nick Eyre, "Residential energy efficiency programmes in the UK: a roadmap for recovery", *Proceedings of British Institute of Energy Economics* (2014), 4-9.
99. Department for Energy and Climate Change, Green Deal Home Improvement Fund reaches £50 million milestone in six weeks, https://www.gov.uk/government/news/green-deal-home-improvement-fund-reaches-50-million-milestone-in-six-weeks (2014).

Chart 4.1: Home improvement measures installed using Green Deal finance in percentage terms, 2013-2015



Source: DECC, "Green Deal and Energy Company Obligation (ECO): headline statistics", (November 2015).

Chart 4.1 shows the different measures that were installed using Green Deal finance during this period. These include the home energy improvements described in detail in Chapter Three, as well as the minor measures listed in Chapter One. The most popular measure was a condensing gas boiler, an energy efficiency measure, with 6,393 installations. While this measure is an improvement on non-condensing gas boilers, it is not consistent with deep decarbonisation, as it is still uses carbon-emitting fossil fuels. The second most popular measure was solar PV, a decentralised renewable technology, with 5,992 installations. The third most popular measure was solid wall insulation, an energy efficiency measure, with 3,026 installations. Fourth was heating controls, with 1,733 installations. Heating controls are a measure to encourage energy saving behaviour. They include thermostats, timers, and programmers to activate or switch off heating to more closely match demand. Fifth was

loft insulation, an energy efficiency measure, with 1,143 installations. Sixth was 'other insulation' with 1,135 measures installed under the Green Deal. This includes smaller energy efficiency measures such as draught proofing, hot water cylinder insulation, and under floor insulation. The two least popular measures were both energy efficiency measures: energy efficient lighting with 383 installations and cavity wall insulation with 389 installations.

Beyond low take-up there were three other failures: failure to leverage private investment into home energy improvements, poor value for money, and failed interaction with the ECO.

First, the scheme failed to leverage private investment into home energy improvement. The recent National Audit Office report finds that just 1% of homes improved between 2013 and 2015 were funded using Green Deal finance. Ninety-seven percent of improvements during this period were delivered free to the consumer or on a discounted basis either through the ECO or one of the temporary Green Deal subsidy schemes, as outlined earlier in this chapter.[100]

Second, for such a small impact, it was a very expensive policy. In total, between 2013 and 2015, the government spent £240 million on the Green Deal. This funding was spent on loans to set up the Green Deal Finance Company, start-up costs for the regulatory framework, and support for local government to promote the scheme in their areas. The average cost to each individual taxpayer for one Green Deal plan was £17,000, and this excludes the cost of the Green Deal Home Improvement Fund, the principal voucher scheme for the Green Deal.

Third, as indicated earlier in this chapter, Ministers intended that ECO and the Green Deal would work together to produce 'blended finance'. However, it is clear that this interaction was not successful. The House of Commons Energy and Climate Change Committee found that there was often an unhelpful competition between the two.[101] This was because

100. National Audit Office, Green Deal and Energy Company Obligation, 35.
101. House of Commons Energy and Climate Change Committee, "The Green Deal: watching brief (part two)", 18-19.

many cheaper measures that the government intended to be financed with the Green Deal could in fact be obtained for free under the ECO. Indeed, as shown above, the overwhelming majority of home energy improvements between 2013 and 2015 were financed by the ECO, or another subsidy scheme. As homeowners are far more likely to prefer free home energy improvements than those paid for by a loan, demand for Green Deal finance was suppressed. Blending was also difficult because ECO and Green Deal had different accreditation schemes.[102]

Furthermore, the reforms to ECO in 2013, as described earlier in this chapter, because of political pressure over rising energy bills, caused one of its original objectives to be lost. To reduce the costs of the scheme to energy suppliers, the Government allowed them to install cheaper measures, such as cavity wall insulation and loft insulation.[103] This meant that the more expensive measures, such as solid wall insulation, were not targeted, and the supply chain did not develop as intended.

In July 2015, after just two and a half years in operation, the Government announced that it would cease funding the Green Deal Finance Company, in effect ending the Green Deal scheme.[104]

As outlined earlier, this section has shown that there were four main features of the Green Deal's poor performance: low take-up, failure to leverage private investment into home energy improvements, poor value for money, and the failed interaction with the ECO. The next section will analyse the possible reasons for the most important failure: low take-up.

Possible reasons for low take-up of the Green Deal

This section examines the reasons why there was low take-up of the Green Deal. The policy's central failure was that there was insufficient demand for the product. There were four possible reasons for this: the

102. Annex, MIMA, 2.
103. Department for Energy and Climate Change, "The future of the Energy Company Obligation", 23.
104. Department for Energy and Climate Change, "Domestic Green Deal and Energy Company Obligation in Great Britain: headline report", 6.

unattractive financial product, the poor communication of the scheme, the poor consumer experience, and problems with the supply chain.

The unattractive financial product

The financial proposition to consumers underpinning the Green Deal lacked broad appeal. Interest rates were typically between 7% and 10% because of the government's decision not to subsidise private lenders' interest rates. This interest rate is competitive for unsecured loans, like personal loans, but wasn't attractive when compared to loans secured against a home.[105] More attractive interest rates could be found elsewhere to fund home energy improvements, for example, through releasing equity from a property.[106] Many able to pay households are also likely to have significant savings, which could be spent on home energy improvements if the cost of finance was unappealing. The fact that just 2.5% of Green Deal assessments resulted in Green Deal plans suggests that some people may have financed the measures through different means.[107]

The high interest rate, combined with the often long repayment period of up to 25 years, meant that the financing costs for Green Deal plans were high.[108] Market research after the Green Deal's launch discovered a number of plans where the credit charge was greater than the cost of installing the measures. For instance, on a £2,500 loan, over 25 years, with an APR of 8.5%, the total amount repaid would be £5,935.15, with financing costs of £3,435.15.[109] Financing costs of around 58% of the total loan was not a good deal.

Added to this was the highly restrictive Golden Rule, which prevented

105. Annex, Association for the Conservation of Energy, 2
106. House of Commons Energy and Climate Change Committee, "The Green Deal: watching brief (part two)", 22; Annex, Sustainable Energy Association, 1; Annex, WWF, 2..
107. Department for Energy and Climate Change, "Domestic Green Deal and Energy Company Obligation in Great Britain: headline report", 6.
108. UK Green Building Council, "Green Deal Finance", 9-10.
109. Green Deal Finance Company, "Green Deal payment plans: the facts", http://www.tgdfc.org/assets/Pamphlet%20and%20Capital%20Ec%20Report/greendeal_leaflet_publicationversion_18.10.13.pdf (2013), 5.

the loan repayments from surpassing the estimated bill savings from the measures. Although intended to protect households from increases in their energy bills, it rendered the whole policy ineffective. It meant that only smaller measures, like loft insulation or draught proofing, could be financed solely using Green Deal finance. These were not inspiring options for households deciding whether to undergo the time-consuming Green Deal process. If the total cost of the measures and credit exceeded the amount that could be borrowed under the Golden Rule, households had to pay a lump sum upfront to access Green Deal finance.

The mean size of Green Deal loans was £3,571, which is insufficient to on its own fund solid wall insulation, double glazing, or a heat pump.[110] Moreover, it is no way near enough financing to allow a deep retrofit of solar PV, solid wall insulation, double glazing, and an air-source heat pump, which would together cost £26,900.[111] The Green Deal aimed to remove the upfront cost of home energy improvements to consumers, and yet the design of the Green Deal effectively necessitated an initial cash payment to unlock the finance package for deep retrofits.[112]

Some single measures were often too expensive to meet the Golden Rule requirement. For example, a typical installation of solid wall insulation might cost a household £9,000.[113] In an average semi-detached household, Department for Energy and Climate Change estimated that the measure would save £232 per year on fuel bills. The maximum annual repayments, therefore, under the Golden Rule, could not exceed £232. Over a 25-year loan (the maximum repayment period for Green

110. This assumes a £50 million loan book across 14,000 Green Deal plans. See National Audit Office, "Green Deal and Energy Company Obligation".
111. These are Department for Energy and Climate Change's central estimates for the cost of each home improvement measure: solar PV (£6,500), solid wall insulation (£9,000), double glazing (£9,000), air-source heat pump (£4,900). See Department for Energy and Climate Change, "Illustrative savings for Green Deal improvement measures".
112. Association for the Conservation of Energy and Bioregional, "Retrofitting the Green Deal", http://www.bioregional.com/wp-content/uploads/2014/10/BioRegional-Retrofitting-the-Green-Deal-Report1.pdf (2014), 9.
113. All estimated figures in this example are from Department for Energy and Climate Change, "Illustrative savings for Green Deal improvement measures", 19.

Deal loans), £5,800 could be borrowed, including financing costs. This comes quite some way short of the £9,000 required to install solid wall insulation, before financing costs are even taken into account.

The combination of the high cost of finance and the restrictive Golden Rule made the Green Deal a very unattractive financial proposition. Moreover, the inclusion of the Golden Rule in the design of the scheme prevented the deep retrofits required to unlock the private and public benefits described in Chapter One.

The poor communication of the scheme

In 2011, before the launch of the scheme, Department for Energy and Climate Change commissioned Ipsos MORI to conduct consumer research through focus groups for the Green Deal. This research found that the most effective message to convince people to engage in the Green Deal was around having a warmer home. They also found that the financial proposition was actually a barrier for many people in getting involved in the scheme, suggesting it was a poor aspect to emphasise in the communication strategy. Participants in the study also highlighted concerns about the small potential for energy savings and the long payback period, which have just been illustrated above.[114]

Yet despite this evidence, the Green Deal was marketed to consumers primarily as a way to save money on energy bills. The government communication campaign launched with two posters, both of which focused on bill savings: "Hate rising energy costs? Green Deal with it" and "Boiler burning money? Green Deal with it".[115] But this almost exclusive focus on the financial proposition of the Green Deal was too narrow. The marketing for the Green Deal was like trying to sell a car to someone by emphasising the merits of the finance package, without first convincing someone they want or need a car.

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114. Department for Energy and Climate Change, "Consumer needs and wants for the Green Deal", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43018/3505-green-deal-consumer-needs-wants.pdf (2011), 16-21.
115. Department for Energy and Climate Change, "Hate rising energy costs? Green Deal with it", https://www.gov.uk/government/news/hate-rising-energy-costs-green-deal-with-it (2013).

The poor consumer experience

The Green Deal failed to take into account homeowners' natural reluctance to having their properties and lives disrupted. Home energy improvement measures are three times as common when carried out as part of other amenity renovations, and only one in ten people have considered installing solely energy-related measures.[116] Consumers do not like taking a piecemeal approach to renovations, and yet that is what the Green Deal required. As shown above, the Golden Rule constraint limited the size of the retrofit that could be installed.

The Green Deal also failed to take advantage of moments when homeowners are likely to carry out other domestic improvements, such as the point of sale, by failing to deploy regulations and financial incentives to drive Green Deal demand at these points. The final chapter will examine how smarter regulations could enable these trigger points to be better utilised.

From being interested in improving the energy consumption of their property, a consumer would have to go through a complicated multi-stage process, interacting with multiple different actors, as shown in Figure 4.1.[117] Not only does this make the Green Deal process unappealing and a hassle for consumers, it also gives interested parties multiple opportunities to drop out mid-way through.[118] The application form for a Green Deal plan was typically 20 pages, compared to the standard five pages for a conventional bank loan.[119] Green Deal plans could only be sold by accredited providers in a customer's home. Most people will buy a financial product online or over the phone, and yet this was explicitly prohibited under the scheme's rules.[120]

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116. UK Energy Research Council, "Understanding homeowners' renovation decisions: findings of the VERD project", http://tyndall.ac.uk/sites/default/files/verd_summary_report_oct13.pdf (2013), 8.
117. Annex, Good Energy, 2.
118. Annex, British Gas, 2.
119. House of Commons Energy and Climate Change Committee, "The Green Deal: watching brief (part 2)", 20
120. House of Commons Public Account Committee, "Oral evidence: Household energy efficiency measures", Q53.

The number of Green Deal assessments from the scheme's launch until the end of 2015 was 614,383, whereas there were just 15,138 Green Deal plans taken out. This shows that between the first and final stage of the Green Deal process, 97.5% of the original number of customers left the process. Part of the effect is that measures were financed through better alternatives, such as ECO or the Green Deal Home Improvement Fund; but part of the effect could also be that the process lost customers because of the poor consumer experience.

The problems with the supply chain

When the Government ended funding for the Green Deal in July 2015, it commissioned Dr Peter Bonfield OBE, Chief Executive of BRE, an advisory organisation on the built environment, to examine the industry standards and consumer protection of home energy improvement schemes.[121] This reflected the fact that there had been serious concerns about the quality of the measures being installed and the framework for ensuring reliable installations. It was likely that a loss of confidence in the Green Deal brand's quality assurance became a barrier to take-up.

Department for Energy and Climate Change's consumer research showed that the guarantee of high-quality that came with Green Deal accreditation was one of the most appealing aspects of the scheme.[122] Yet there were reports that some consumers encountered rogue traders among installers.[123] Around 11% of Green Deal assessors and 14% of Green Deal installers were suspended from the scheme because of poor workmanship.[124] Moreover, when work was poorly carried out, the redress frameworks for Green Deal providers were patchy and

121. Department for Energy and Climate Change, "Bonfield review terms of reference", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/465119/150721_Independent_Review_-_short_ToR_-_REV.pdf (2015).
122. Department for Energy and Climate Change, "Consumer needs and wants for the Green Deal", 16.
123. House of Commons Energy and Climate Change Committee, "The Green Deal: watching brief (part 2)", 15.
124. Jan Rosenow and Nick Eyre, "A post mortem of the Green Deal: Austerity, energy efficiency, and failure in British energy policy", *Energy Research and Social Science* (2016), 141-144.

inconsistent, with different ombudsmen covering different stages of the process.[125]

Box 4.2. Problems with the Green Deal supply chain development

In 2014, Department for Energy and Climate Change commissioned research into why businesses working in the energy efficiency and decentralised renewable supply chain did not choose to get involved in the Green Deal supply chain.[126] The report identified a number of barriers to entry.

First, the cost of registering to become accredited was £10,000, which was too high for many small businesses and sole tradespeople, particularly given the lack of demand for the Green Deal scheme.[127]

Second, the accreditation schemes were overly complex and bureaucratic. They were time-consuming to comply with, and were seen as often overlapping with other accreditation schemes without adding additional value.

Third, the political uncertainty over the longevity of the Green Deal scheme meant that suppliers did not have confidence to invest the time in the training and accreditation process. The short-term nature of the financial incentives, such as the Green Deal Home Improvement Fund, described earlier in this chapter, caused inconsistent patterns of consumer demand. These boom-bust cycles in the volume of available business in turn meant that the supply chain for home energy improvements did not have the confidence to invest and grow, and so was unable to develop sustainably.[128]

125. Annex, Ombudsman Services, 1.
126. Department for Energy and Climate Change, "Research into businesses that were not certified Green Deal suppliers", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/388068/Green_Deal_Supply_chain_non-participant_research_FINAL_PUBLISHED.pdf (2014), 20-21.
127. Annex, Energy and Utilities Alliance, 1.
128. Annex, MIMA, 1.

These features of the scheme favoured large energy companies over local tradesmen, who are better at managing cost, bureaucracy and risk. This meant that the expertise, local knowledge, trust, and customer base of small building companies were under-utilised in the Green Deal scheme.

In short, the Green Deal failed to properly drive consumer demand, which led to low levels of take-up of the scheme. The combination of incentives, marketing and regulatory compulsion was insufficient to increase uptake of home energy improvements. Those consumers that were interested in the scheme did not have a positive, straightforward journey. This in turn led to an underdeveloped supply chain that was unappealing to potential new entrants.

This chapter has shown how the Green Deal failed to meet the high expectations set by Ministers. Instead of the 14 million homes improved by 2020 under the scheme, there had been just over 15,000 Green Deal plans sold when the scheme closed in July 2015. Aspects of the policy, such as the pay as you save mechanism, were sound. But others, such as the Golden Rule and the complexity of the customer journey, undermined the scheme. The next chapter will consider what modifications to the Green Deal policy the Government can make to overcome some of these problems.

Chapter 5: Policies for a new home energy improvement scheme

The previous chapter showed how progress in retrofitting energy efficiency measures and decentralised renewables – crucial for making households consume less and greener energy – has been slower than required. This is in part down to the failure of policies like the Green Deal that were intended to incentivise more home energy improvements. This chapter will outline in detail the attributes of the Green Deal, the reasons for failure, and the policy lessons that should be learned.

Policy approach

There is no single solution to stimulating the home energy improvement market. It will require a suite of policies to increase up-take and address the main reasons for failure, which were identified in Chapter Four: an unattractive finance mechanism, the poor communication of the scheme, the poor consumer journey, and issues around the quality of the supply chain.

There are four main types of policies that we propose: improving the communication of the scheme, making the financial package more attractive, strengthening regulation for customers, and bolstering the supply chain.

Ultimately, a new scheme should increase take-up of deep retrofits of home energy improvements to lead to a significant reduction in carbon emission from homes and greater energy security. However, when formulating policies, we applied two particular key tests that

had to be met:

- **Recognising fiscal realism.** The Government is committed to reducing the budget deficit, and so cannot implement expensive new policies. We do not shy away from proposing a policy that carries a cost. However, we are conscious that there is a limit to the amount of money that can be spent in this policy area.
- **Stimulating the market.** The previous Green Deal scheme failed to drive consumer demand, which in turn damaged the confidence of the supply chain. New policies must be more successful at expanding this market, enabling small businesses to flourish, leveraging private investment, and ultimately improving the productivity of the economy.

Improving the communication of the scheme

Recommendation one: create a new home improvement scheme

Public trust in the Green Deal brand has been undermined due to its poor performance. Its successor will require new policies and should be rebranded. The new package we propose should be framed as a home improvement scheme, rather than as the 'Green Deal'. Schemes that market themselves as 'green' limit their appeal.[129] To become part of the mainstream consumer market, energy efficiency measures and decentralised renewables need to be seen as another domestic renovation, rather than simply an environmental measure.

There are other reasons why the rebranding from Green Deal to a home improvement scheme is justified. While they often do not create an aesthetically pleasing product like other home refurbishments

129. Department for Energy and Climate Change consumer research found that just 17% of respondents would consider installing home energy improvements to reduce carbon emissions. See Department for Energy and Climate Change, "Green Deal household tracker survey: wave 4 report", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/320364/gd_tracker_w4_report.pdf (2014), 25.

– you can't 'see' cavity wall insulation in the same way that you can see an attractive new kitchen – there are tangible improvements to the householders' quality of life, such as increased warmth, greater comfort, and better health outcomes.[130] In the case of solid wall insulation, home energy improvements can even make the building's exterior more attractive. Similarly, like with other home improvements, energy retrofits add value to people's properties.[131]

Box 5.1. Expanding the eligible home energy improvement measures

The list of eligible home energy improvement measures for the scheme should also be expanded, to create a more inspiring set of home improvement options to appeal to consumers. All the energy efficiency measures and decentralised renewables we described in Chapter Three will be included. But also, battery storage, a decentralised renewable electricity technology, which is crucial for overcoming the intermittency of decentralised renewables and for minimising households' energy costs, should be included. Smart appliances, such as smart fridges or smart washing machines, which are connected to the home's smart meter and encourage energy saving behaviour, should also be eligible under the scheme.

The consumer journey for the Green Deal was complex and involved multiple interactions with different agents, as demonstrated in Chapter Four. For this reason, a regional network of 'one stop shops', with an accessible digital interface, should be created. This would provide advice to consumers on how to navigate the new scheme, from receiving an assessment to having the home energy improvements installed. It would also provide a register of assessors and installers.

130. House of Commons Energy and Climate Change Committee, "Home energy efficiency and demand reduction", http://www.publications.parliament.uk/pa/cm201516/cmselect/cmenergy/552/552.pdf (2016), 28-30.
131. Department for Energy and Climate Change, "An investigation of the effect of EPC ratings on house prices".

This body could be part-funded by the government, using the money that it spent on the Green Deal Communities scheme, which funded local authorities to promote the Green Deal in their areas. It could also be part-funded by the registration fees of assessors and installers, as the Green Deal Oversight and Regulation Body was under the old scheme.

Therefore, our first recommendation is that the new package offered by government should be framed as a home improvement scheme. It should be communicated to consumers as a policy to make properties warmer, healthier, and more valuable, rather than as a 'green measure'. It should include energy efficiency measures and decentralised renewables, as well as new measures such as battery storage and smart appliances. It should be communicated and explained to consumers through the establishment of a new regional network of one stop shops. The details of this new scheme, and how they differ from the Green Deal, are described below.

Making the finance package more attractive

The pay as you save financing mechanism, as described in Chapter Four, that underpinned the Green Deal should be retained in the new Help to Improve scheme.[132] It was originally established to remove the upfront cost of home energy improvements, so that they would be more affordable and ensure they did not directly compete with other household expenditure priorities. The financing mechanism was also designed not to affect an individual's credit rating, as the loan was attached to the energy bill of the property. Consequently, it was not a personal loan or a mortgage. This meant that Green Deal financing did not affect the ability of households to borrow to pay for new kitchens, extensions, or other improvements.

However, the government made this very attractive off-balance sheet financing proposition fundamentally very unappealing. The cost of

132. This was a key theme of the evidence we reviewed. See Annexe, Jan Rosenow (Centre for Innovation and Demand Reduction), 1; Annexe, Energy and Utilities Alliance, 2; Annexe, UK Association for the Conservation of Energy, 3; Annexe, Knauf, 2; Annexe, Energy Saving Trust, 1.

finance for the Green Deal ended up being much higher than it should have been – certainly higher than mortgage rates of interest and even higher than many personal loans or credit cards. This was a result of the relatively high borrowing costs of private sector lenders, and the government's decision not to subsidise the interest rate.

The available evidence suggests that creating mass demand for home energy improvements will be impossible without some form of government support, such as subsiding loans or tax incentives.[133] As detailed in Box 4.1, home energy improvement schemes in comparable countries, such as France and Germany, rely on taxpayer funding to create the sufficient demand to meet government policy objectives.[134]

In this section, we propose four improvements to the financing mechanism that address these shortfalls, that will help to unleash the pay as you save model.

Recommendation two: introduce 'Help to Improve' loans

The Government should offer Help to Improve loans, which would be a sister policy to 'Help to Buy'. They should underwrite the loans using funding from the UK Guarantees scheme for infrastructure (see Box 5.2 for further details).[135] All households that have had an assessment should be eligible for this scheme.

The government should raise the capital for the Help to Improve loans from the international bond markets using its historically low borrowing costs.[136] By underwriting households' home improvement loans, the government would pass on this cheap cost of capital to households, whose loans would now have cheaper interest rates than were offered under the old Green Deal.

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133. Annexe, Jan Rosenow (Centre for Innovation and Demand Reduction), 2.
134. Ricardo AEA, "A comparative review of housing energy efficiency interventions", http://www.climatexchange.org.uk/files/8814/4594/0740/final_report_261015.pdf (2014), 16-17.
135. A version of this policy was recommended in Jan Rosenow and Richard Sagar, "After the Green Deal: empowering people and places to improve their homes", http://www.respublica.org.uk/wp-content/uploads/2015/09/After-the-Green-Deal.pdf (2015), 8; Annexe, UK Green Building Council, 3; MIMA, 3.
136. Elaine Moore, "UK 10-year gilt yield falls below 1%", *Financial Times*, June 27, 2016

Box 5.2. The UK Guarantees scheme for infrastructure

The UK Guarantees scheme for infrastructure was launched in 2012 to provide government-backed guarantees to infrastructure projects.[137] The aim of the policy was to speed up infrastructure investment and enable private investors to get access to reliable financing. Up to £40 billion in aggregate (excluding interest) has been offered so far under the scheme. At the end of 2014, seven projects had been extended £1.7 billion worth of guarantees, and there remained 39 projects (including Hinkley Point C nuclear power station) worth £24 billion that had successfully prequalified for the scheme.

The scheme is currently scheduled to close in December 2016. To comply with EU state aid rules, the scheme had to charge investors a market-oriented fee so that the guarantee did not count as a subsidy. However, following the recent vote to leave the EU, this requirement can now be lifted, enabling the government to pass on its low borrowing cost to private households to boost productivity investments.

Home energy improvements are a major investment in UK infrastructure, which boost productivity and long-term growth. As the government is currently examining options for new infrastructure spending, this policy would provide a quick fiscal stimulus to the economy, as there is already a significant home energy improvement supply chain in place.

Current home energy improvements schemes in comparable countries such as France and Germany provide cheap financing for households. For example, as shown in Box 4.1 earlier, the German government spends over €2 billion annually to lower the interest rate for retrofit loans to 1%. However, because of Germany's low borrowing costs and the tax revenue the additional economic activity from home

137. National Audit Office, "UK Guarantees scheme for infrastructure", https://www.nao.org.uk/wp-content/uploads/2015/01/UK-Guarantees-scheme-for-infrastructure.pdf (2015).

improvements generates, the policy actually raises money for the German exchequer. It has been found that for every €1 of public money spent on the KfW programme, €4 is earned by the Treasury in taxes and reduced welfare spending.[138]

It is likely that the UK will see a net fiscal benefit from the proposed Help to Improve loans. But to ensure government costs were controlled, several measures could be introduced. The annual budget for the Help to Improve scheme could be capped, the maximum size of each home improvement loan could be limited, or the number of loans supported by government annually could be controlled.

Since the Green Deal Finance Company is in the process of being sold off, high street banks could provide the loans for the Help to Improve scheme. There is good evidence that the private sector would perform this function. Before the government's decision to establish and part-subsidise the Green Deal Finance Company, a number of private-sector companies were interested in financing the Green Deal scheme.[139] High-street lenders provide retrofit loans in France and Germany, and they are better placed to promote the scheme to their existing retail customers. This would also help to frame the Help to Improve scheme as a mainstream proposition, and stimulate a market in home improvement schemes.

Recommendation three: introduce a new 'Help to Improve ISA'

The government should introduce a 'Help to Improve ISA', which would be a sister policy to the Help to Buy ISA introduced in the 2015 Budget. Under the Help to Buy ISA, first time buyers that choose to save through a Help to Buy ISA receive a bonus worth 25% of the amount saved when they buy their first home.[140] There is a

138. Energy Bill Revolution, "A housing stock fit for the future: making home energy efficiency a national infrastructure priority", http://www.energybillrevolution.org/wp-content/uploads/2014/08/A-housing-stock-fit-for-the-future-Making-home-energy-efficiency-a-national-infrastructure-priority-3.pdf (2014), 4.
139. Marksman Consulting, 1.
140. Her Majesty's Treasury, "Help to Buy ISA: scheme outline", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/413899/Help_to_Buy_ISA_Guidance.pdf (2015), 2.

maximum government contribution of £3,000 on £12,000 of savings. An equivalent scheme should be established for Help to Improve. This could help increase savings rates, and increase the amount of private capital available to finance the upfront costs of home energy improvements or to reduce the loan repayments, further stimulating the market. Demand for this scheme will be limited by low savings rates and the existence of competing government-supported savings schemes. This means the scheme will be fiscally realistic.

Recommendation four: scrap the 'Golden Rule' on home improvement loans

The Golden Rule constrained the amount of money that could be borrowed under the Green Deal, as it mandated that loan repayments could not exceed estimated energy savings of the measures. This led to the average (mean) Green Deal loan being just £3,500, as shown in Chapter Four. This was insufficient to finance the more expensive home improvement measures, such as solid wall insulation, without paying an upfront lump sum.

The Golden Rule requirement should be scrapped. Removing the Golden Rule would enable deep retrofits to be financed under the new Help to Improve scheme, rather than just cheap individual measures. Without the Golden Rule, tens of thousands of pounds could be borrowed, allowing a powerful combination of decentralised renewables and energy efficiency measures, as well as smart appliances and battery storage to be installed and entirely financed by a new home improvement loan. This will stimulate the market by enabling a greater range and number of home energy improvements than were installed under the Green Deal.

Removing the Golden Rule limit would also enable other financial constraints in the scheme to be liberalised. To keep monthly repayments small enough to meet the Golden Rule, the payback period of the Green Deal loans could be up to 25 years. This would not be necessary under the new home improvement scheme, as loans could be amortised over

shorter or longer periods, depending on the personal preferences of the household.

The removal of the Golden Rule will entail some loss of consumer protection, as the government will no longer impose limits on the amount of money that a consumer can borrow and be made to repay. However, there will still be a credit check before a Green Deal loan can be taken out, meaning the risk of 'sub-prime' loans is small. The evidence from Germany, where there is no such Golden Rule constraint, also suggests this consumer protection is unnecessary.[141]

While it is right for households to be given all the information about future repayments, the government shouldn't be paternalistic about how much individuals can borrow from the private sector, as it did with the Green Deal. The new home improvement scheme will enable individuals to take personal responsibility for their own financial decisions. Furthermore, as it is individuals' own money that they will be repaying, this will act as a natural limit on the amount borrowed, thereby making this policy fiscally realistic.

Recommendation five: integrate revenue to households from the Renewable Heat Incentive (RHI) and the Feed in Tariff (FIT) into the new home improvement scheme

The existing subsidy regimes for decentralised renewables, which we detailed in Chapter Four, should be folded into the new home improvement scheme. The Government expects to spend £1.3 billion annually on FIT and £1.2 billion on the Renewable Heat Incentive (RHI) by the end of the Parliament, including for historic accreditations. The revenue households receive from these schemes should instead be deducted from their home improvement loan repayments, mitigating in part their higher energy bills.[142] This change would also help to streamline the incentive structure, making the home energy improvement market easier for consumers to understand,

141. Jan Rosenow et al, "Overcoming the upfront investment barrier", 94.
142. Annex, Good Energy, 4; Energy Saving Trust, 5.

and to link together energy efficiency measures and decentralised renewables. There is no added cost of this policy because it is taking existing government expenditure.

As subsidies via the RHI and FITs are gradually phased out as renewables become cost competitive without subsidy, home improvement loans could become the primary means for government to support their deployment in the domestic sector. Even if renewables are cost competitive without subsidy – as they now are in many circumstances – households may still have trouble finding the upfront capital to install them. The home improvement loans can address this problem.

Strengthening regulation for customers

Regulation is another important component of creating the demand for mass uptake of home energy improvements. Regulation should be used carefully, but, in the past, it has proven to be effective at changing consumer behaviour around energy consumption, and reducing carbon emissions. For instance, in 2005 regulations were introduced that mandated all new and replacement gas boilers to be more efficient condensing boilers. This has seen the share of condensing boilers rise from 2% in 2001 to 53% in 2014.[143] Similarly, the Coalition Government introduced regulation about the energy performance of properties rented out by private-sector landlords. These will prevent properties with an Energy Performance Certificate (EPC) rating below E from being rented out from 2018.[144]

Recommendation six: introduce minimum energy performance standards for properties at the point of sale and when other renovations on the property are carried out

Blanket regulation imposing minimum energy performance standards

143. Department for Communities and Local Government, "English housing survey: headline report", 37.
144. Annex, MIMA, 4.

across the entire housing stock is not currently politically feasible, as it would be an unacceptable level of intrusion into private property. Instead, regulation should be targeted at specific 'trigger points', when households are more likely to consider home energy renovations. Consumer research has found that one in four renovations are caused by trigger points, such as boiler failure.[145]

Two potential trigger points for the able to pay sector are when a house is being sold, and when other building work is being done to the property.[146] Regulation at these two trigger points would drive consumer demand for the new home improvement scheme. There should of course be a long lead-in time, so that homeowners and the supply chain can prepare and minimise their costs.

First, prior to the sale of a property, homeowners often consider doing renovations to increase the value of their home to potential buyers. At this point, they are required by law to have their home's energy performance formally assessed by an Energy Performance Certificate (EPC) and provide it to the next owner prior to the completion of the sale. EPCs are awarded to property owners by accredited energy assessors, ranging from A (highest) and G (lowest).[147] The rating is based on a number of elements, including all the home energy improvements discussed in this report: the heating system used, wall insulation, levels of roof insulation, and amount and type of glazing. Regulation could be used to mandate a minimum rating on the EPC for homes that are sold. The minimum EPC rating should be gradually increased over time in order to meet the UK's carbon budgets. The government needs to carefully consider which buildings these regulations will apply to, such

145. UK Energy Research Council, "Understanding homeowners' renovation decisions", 5.
146. Westminster Sustainable Business Forum, "Warmer and greener: a guide to the future of domestic energy efficiency policy", http://www.policyconnect.org.uk/wsbf/sites/site_wsbf/files/report/761/fieldreportdownload/warmergreenerreport.pdf (2016), 28-29; Bioregional, "Retrofitting the Green Deal", 15.
147. Department for Communities and Local Government, "Improving the energy efficiency of our buildings: A guide to energy performance certificates for the marketing, sale and let of dwellings", https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/307556/Improving_the_energy_efficiency_of_our_buildings_-_guide_for_the_marketing__sale_and_let_of_dwellings.pdf (2014).

as buildings with multiple occupants or listed buildings.

Second, home energy improvements could be mandated in building regulations when any home improvement works are undertaken on a property. People are three times more likely to consider home energy improvements as part of a package of other renovations rather than on their own.[148] Therefore, the Government could regulate so that any home improvement work carried out on a property must also improve the property's overall energy performance levels. To minimise the costs of the measures for individuals, the building regulations could set a limit on the cost of the home energy improvements that would have to be introduced. For example, they could mandate that the cost of the home energy improvements cannot exceed a certain percentage of the overall cost of the building works. This regulation would be enforced in the same way that the building code, the regulations that govern building works, is currently enforced.

While the proposed regulations do add costs to households, the new home improvement scheme we have proposed in this report means that there would be no upfront cost for the home energy improvements, and repayments would be made in instalments on consumers' energy bills. The government would have to think carefully about the exact minimum energy performance that would apply at the point of sale and when building work is undertaken. The exact rating would have to be demanding enough to achieve the reductions in energy use to meet carbon emissions targets and guarantee energy security, but not too burdensome that it would be financially punitive for those on more modest incomes.

Bolstering the supply chain

The last chapter analysed the problems with the supply chain that affected consumer demand and limited uptake of home energy improvements. These included: a complex accreditation scheme that

148. UK Energy Research Council, "Understanding homeowners' renovation decisions", 8.

was a barrier to new entrants in the supply chain, a complex consumer journey, and poor quality installations. In this section, we propose two new policies to address these shortfalls.

Recommendation seven: offer free training and reduced registration fees for small businesses and local tradespeople

More local tradespeople and small and medium enterprises (SMEs) should be encouraged to join the supply chain for home energy improvements. While large energy companies have a role to play in the home energy improvement market, particularly by delivering the measures mandated under the ECO scheme that was outlined in Chapter Four, they seem to be less trusted by consumers, and so may not be the right people to front this home improvement programme.[149] Moreover, tradespeople are best placed to market energy efficiency measures and decentralised renewables to their localised networks of customers, and bring retrofits into the mainstream of home improvement.[150]

Tradespeople can also recommend home energy improvements to their customers alongside other renovations, maximising the opportunities of trigger points. Consumer research has found that 85% of households considering general renovations will stretch their budget to include energy efficiency measures.[151] This policy complements the previous recommendation to introduce energy performance regulation when general renovations are being undertaken.

To become an accredited Green Deal installer, installers had to pay £10,000, as shown in Chapter Four. This was a barrier for SMEs entering the market.[152] Similarly, local tradespeople that are not specialists in home energy improvements require training to acquire the requisite

149. Annex, Durham Energy Institute, 4.
150. Catrin Maby and Alice Owen, "Installer power: the key to unlocking low-carbon retrofit in private housing", http://ukace.org/wp-content/uploads/2015/12/Installer-Power-report-2015.pdf (2015), 11-13.
151. Energy Saving Trust, "Trigger points: a convenient truth", http://www.energysavingtrust.org.uk/sites/default/files/reports/EST_Trigger_Points_report.pdf (2015), 12.
152. Annex, Energy and Utilities Alliance, 1.

skills to install these measures. Both the time away from other renovation work and the upfront cost to attend these training sessions can be another barrier to SMEs becoming involved. Therefore, we are recommending that the Government subsidise registration fees to become accredited for local tradespeople and SMEs, and provide free training sessions. This will help encourage more of this important part of the supply chain to sign up to provide the new home improvement scheme, giving a supply-side stimulus to the market, which is one of our principal policy aims.

Recommendation eight: introduce a new, single accreditation scheme for all installers of home energy improvements

The Bonfield Review, set up by the Government after the decision to end funding for the Green Deal, is expected to make recommendations on how to improve the quality assurance framework for home energy improvements. As we found in Chapter Four, there were widespread concerns about the quality of some of the installations that took place under the Green Deal.

It is vital that the new accreditation scheme should replace existing regulations, rather than duplicating them, so that new entrants to the supply chain are not deterred from joining the new scheme by costly and time-consuming regulation.[153] Less competition among suppliers would in turn drive up costs for consumers.

Therefore, we recommend that a single, simplified accreditation scheme should replace the existing Green Deal accreditation scheme and the separate Microgeneration Certification Scheme for decentralised renewables. Installers could pay a general registration fee to acquire accredited status and, within that overall scheme, seek separate authorisation to install particular home energy improvement measures. If the installers wanted to become accredited to install other home improvement measures, they could do so through this scheme.

This would enable consumers to have trust in a new robust brand that

153. Annex, Durham Energy Institute, 2.

is simpler to understand and has wider public awareness than the old schemes. It would also minimise the administrative burden on suppliers. The aggregate effect of this policy could be to stimulate the market, increasing consumer demand and bolstering the supply chain.

Conclusion

Figure 5.1 summarises all the policies we propose.

Figure 5.1. The new home improvement scheme

Together, they create a new deal to significantly increase demand for a home energy improvement scheme in the able to pay sector.

Although the new home improvement scheme would now not be suitable for those in fuel poverty, as it is likely that fuel bills will increase by more than the energy savings from the measures, the Government has committed to reforming the ECO by 2017 to focus exclusively on the

fuel poor. There will be other government policies in place that will help that group.

We have analysed the different options for homeowners that install energy efficiency measures and decentralised renewables. There is a significant need in particular for expensive measures such as solid wall insulation and heat pumps, which also offer the largest long-term carbon emission reductions.

The Green Deal scheme set up an innovative financial product and accreditation scheme to increase take-up of these improvements. But consumer demand for these measures was low. The proposals in this report will address the main problems with the Green Deal scheme, to revitalise the market for home energy improvements in the able to pay domestic sector in a cost-effective way.

We urgently need a new home energy improvement scheme to ensure households consume less and greener energy.

Annex:
Written evidence

Evidence from Association for the Conservation of Energy
Click here to read the submission

Evidence from Behaviour Change
Click here to read the submission

Evidence from British Gas
Click here to read the submission

Evidence from Donal Brown (CIED)
Click here to read the submission

Evidence from the Durham Energy Institute
Click here to read the submission

Evidence from E.ON
Click here to read the submission

Evidence from Energy and Utilities Alliance
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Evidence from the Energy Saving Trust
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Evidence from Good Energy
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Evidence from Jan Rosenow (CIED)
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Evidence from Knauf Insulation
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Evidence from Marksman Consulting
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Evidence from MIMA
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Evidence from Rockwool
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Evidence from the RSPB
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Evidence from SSE
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Evidence from the Sustainable Energy Association
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Evidence from the UK Green Building Council
Click here to read the submission

Evidence from WWF-UK
Click here to read the submission

Homes in the UK need to consume less and greener energy so that important targets for reducing carbon emissions are achieved. Government sought to incentivise home energy improvements by creating the Green Deal in 2013, but this was a failure and ended after two years. There is now a policy vacuum.

This report examines the current market in energy efficiency measures and decentralised renewable technologies, and the possible reasons for the Green Deal's failure. It proposes a new home energy improvement scheme in the able to pay sector.

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