Rialtas na hÉireann
Government of Ireland

Spending Review 2020

Grant Schemes for Energy Efficiency: Better Energy Homes and Better Energy Communities

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Executive Summary

- Ireland uses a variety of grant-based instruments to incentivise homeowners to engage in retrofit activity. For homeowners, there are two key schemes:
    - Better Energy Homes (BEH) offers a range of individual grants to encourage private households to adopt measures while;
    - Better Energy Communities (BEC) scheme encourages a community-based approach to retrofit.

- Since their inception, €284.9 million and €120.2 million of Exchequer funding has been invested in the schemes respectively. This paper finds that when applying an investment appraisal framework via the Public Spending Code, the Exchequer investment is considered to generate a Net Benefit to society across both schemes. In other words, the present day discounted value of the estimated future CO_2 savings outweighs the Exchequer investment cost.

- This analysis has limitations. The Exchequer cost only covers a portion of the total investment cost incurred, since the majority of investment cost is met by private householders. This conclusion is also heavily dependent on assumptions around the savings generated and the lifespan of investments. However, wider co-benefits to society and the energy bill savings that accrue to householders were also not evaluated.

- It should also be noted that the vast majority of retrofits delivered by both schemes were relatively shallow. Particularly, while the BEH scheme delivers significant energy reductions, the level of work done seldom brings a household to a BER B2. The BEC scheme in recent years has closer aligned itself to the B2 target, which has led to a decline in the number of houses upgraded under this scheme.

- Ultimately, this paper finds that these existing support schemes, while effective prior to the Climate Action Plan, are not sufficient to achieve the goals set out in the Climate Action Plan and Programme for Government. New schemes are required which will align with the BER-B2 and Heat pump targets.

Key Findings

- In 2019, SEAI spend per home on the BEH scheme was €1,298. For the BEC scheme, SEAI spend per home upgraded was significantly higher at €31,032.

- Taking into account the revised shadow cost of carbon values in the Public spending code, the present value of the emissions savings enabled by the Exchequer investment in Better Energy Homes is valued at approximately €303m, with the emissions savings generated by Better Energy Communities valued at nearly €155m. Again, it should be noted that the Exchequer investment is only a portion of the total investment made.

- There is a considerable degree of uncertainty surrounding the likely average investment to bring a house to a BER-B2 or cost-optimal equivalent energy efficiency level. An average figure also disguises considerable variability in the cost that might be faced by an individual homeowner. This uncertainty is also mirrored in the energy and emissions savings experienced in each home. More research on this variability is necessary to underpin future energy efficiency schemes.

- The Programme for Government reaffirms the commitment to achieve 500,000 deep retrofits, along with the installation of 400,000 renewable heat systems in existing homes. This commitment is to be funded with the €3.7 billion allocated in Project Ireland, complemented with €5 billion from carbon tax revenues which the Programme for Government states will *"part fund a socially progressive national retrofitting programme targeting all homes but with a particular emphasis on social and low-income tenancies."*

- It is clear that existing energy efficiency support schemes, while providing a net benefit to society, are not sufficiently geared towards the achievement of the Programme for Government and Climate Action Plan Targets. New schemes are required and given the significant level of Exchequer funding envisaged in the Programme for Government, extremely careful consideration will be required in their design and operation.

1. Introduction

Support schemes for residential energy efficiency were introduced by the Government in 2009 on a pilot basis, with subsequent Governments strongly committing to the principle of supporting households to reduce their energy consumption through improved efficiency.

The Programme for Partnership Government in 2016 outlined the then Government's intention to focus on the role of energy efficiency and the use of renewable energies in residential and other buildings, with the aim of reducing emissions while simultaneously making homes healthier, more comfortable and more efficient[1].

Project Ireland 2040 built on this commitment by pledging to ramp up the scale of energy efficiency upgrades from 30,000 to 45,000 homes per annum from 2021 to achieve a minimum BER rating "B", while also offering supports for changing out oil-fired boilers to heat pumps, along with the provision of roof solar in at least 170,000 homes by 2040.

The Climate Action Plan of 2019 increased this ambition by aiming to increase the number of buildings retrofitted to a B2 or cost optimal equivalent[2] BER to approximately 500,000 by 2030 while also installing approximately 400,000 heat pumps in existing residential buildings by 2030.

This commitment is reiterated in the most recent Programme for Government, Our Shared Future, with a range of supporting actions also committed to, from the use of one stop shops to make the renovation process easier for homeowners, to the investigation of financing options to assist them with the funding of these upgrades.

This paper has been completed as part of the 2020 Spending Review Process. The Spending Review aims to create a body of evidence on the efficiency and effectiveness of existing areas of expenditure that can be used to inform the budgetary process. The paper has been drafted by IGEES staff within the Department of Public Expenditure and Reform, in conjunction with staff from the relevant Departments and Governmental Agencies, who supplied relevant data and information.

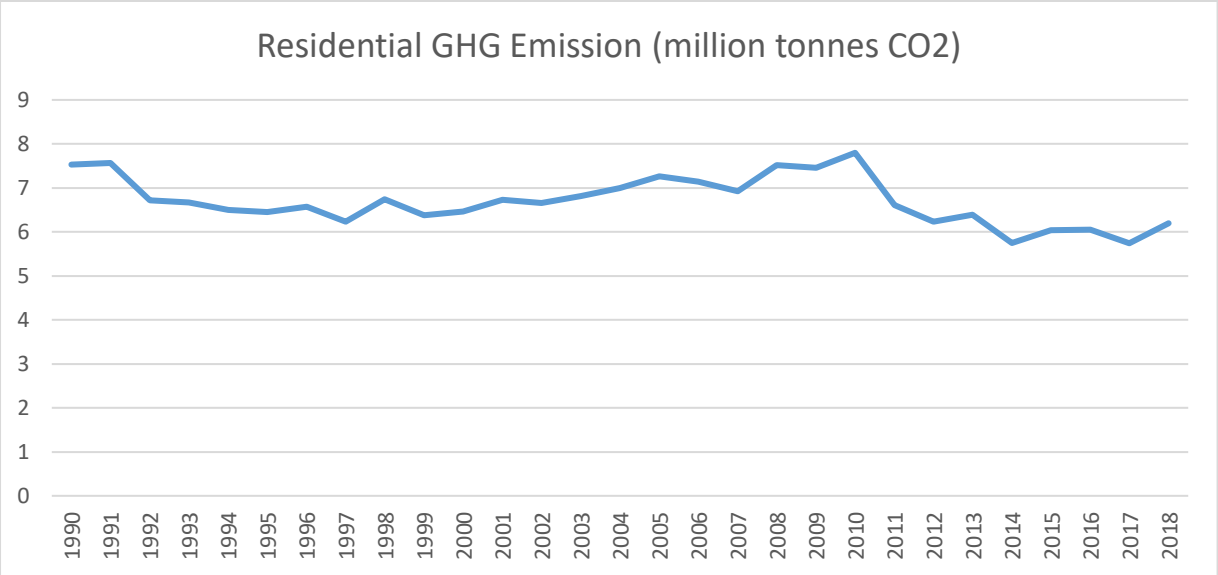
1.1 Emissions from the Irish Housing Stock

There are an estimated 1.7 million inhabited homes in Ireland and 6.2 million tonnes of Greenhouse gas emissions came from homes in 2018. This equates to roughly 10.2% of national emissions[3][4] or 24%

[1] https://merrionstreet.ie/MerrionStreet/en/ImageLibrary/Programme_for_Partnership_Government.pdf
[2] A 'cost-optimal' level requires insulation of the walls and roof to be upgraded to standards set out in building regulations. A heating system must also be replaced if it is less than 86 percent efficient, or 45 percent retention for electrical storage heating.
[3] National Emissions refer to Emissions that are not regulated by the Emissions Trading System (ETS)
[4] These are direct emissions and do not include upstream electricity emissions

of energy-related CO2 emissions. The level of greenhouse gas emissions from homes has been on a relatively consistent downward trajectory since 2010 and is considerably the level of emissions attributable to the sector in 1990. Since Ireland's population has increased quite considerably since 1990, this is strong evidence that energy efficiency levels have been improving in the residential sector sufficient to offset the growth in the number of households.

Figure 1: Residential Greenhouse Gas Emissions 1990-2018

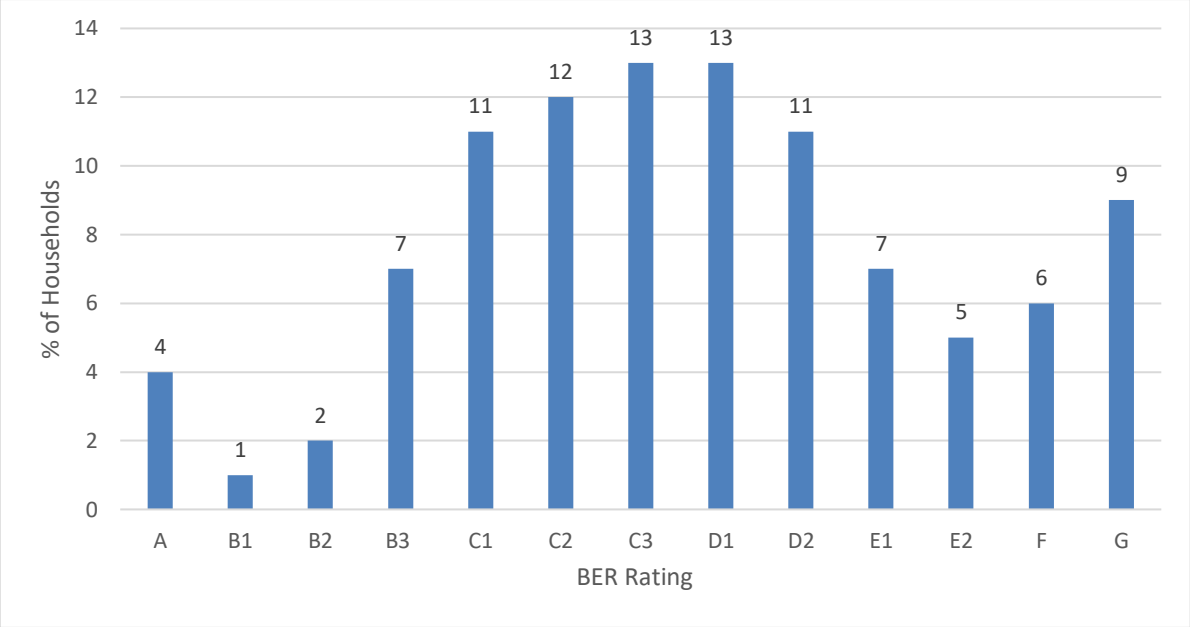


However, the Environmental Protection Agency (EPA) projects that residential emissions under existing measures will increase marginally between 2018 and 2020 and only fall by around 15% over the period to 2030. This is inadequate to achieve the targets set out in the Climate Action Plan and Programme for Government.

Despite the fall in emissions since 1990, Ireland's homes are still an outlier in European terms. Ireland's energy consumption per dwelling is among the highest in Europe and the typical Irish home emits 7% more energy and 60% more greenhouse gas emissions than the EU average[5]. This is due to larger than average homes which are typically poorly insulated and heated via carbon intensive fuels, such as oil. Approximately 51% of the Irish housing stock assessed for their BER have a rating of D1 or worse, while just 7% have a rating of B2 or better[6].

[5] https://www.seai.ie/data-and-insights/seai-statistics/key-publications/energy-in-residential-sector/
[6] https://www.cso.ie/en/releasesandpublications/er/dber/domesticbuildingenergyratingsquarter32020/

Figure 2. Percentage of Households under each BER rating



SEAI estimate that the average Irish household emitted 4.8 tonnes of CO2 in 2018. 69% of this came from direct fuel use in the home and the remainder from electricity use. This is down quite considerably from 8.4 tonnes in 2005. This improvement is attributable to considerable falls in the number of homes heated by coal and peat as well as improvements in energy efficiency and the growth in gas as a home heating fuel.

Collectively, Irish households spend an estimated €5 billion a year on energy costs[7]. However, this sum is dwarfed by the scale of the renovation challenge. Previous public estimates from SEAI have suggested that an average investment of €25k per home would be required to upgrade a typical home to a minimum BER rating of B2. An inter-departmental Retrofit Taskforce is currently examining the question of the average cost and total cost of the first 500,000 home and hence, revised figures will be available in the coming months.

1.2 Government Support for Energy Efficiency

Since 2009, SEAI on behalf of the Government, has supported the retrofit over 400,000 homes. While the main focus of these works have been on shallow measures, the quantity of homes supported has reached over 50,000 homes in a single year. Since 2018, there have been some reforms to retrofit programmes to assist with a move to deeper measures, with approximately 1,500 homes completed

[7] https://www.seai.ie/publications/Energy-in-Ireland-2019-.pdf

to a B2 efficiency level in 2019. The Government target for 2020 is 3,500 homes improved to a B2 or cost-optimal equivalent rating.

Government support has been provided as it has been considered that few households are currently prepared or able to make this investment. Previous SEAI research suggests that approximately 70% of owner-occupiers and 60% of tenants think that they can reduce energy usage and do consider energy efficiency upgrade options[8]. However, detailed knowledge is lacking, with many finding it difficult to differentiate efficiency upgrades from general home improvement. The research suggests that people tend to overestimate the potential time and cost involved, while not appreciating the scope to reduce their energy bills or the wider benefits. Disruption or "hassle" is also a de-motivating factor[9].

The use of policy support mechanisms has been a key feature of the development of the private household sector for energy efficiency retrofits globally. The deployment of these measures has been used to overcome or alleviate the barriers to undertaking a retrofit, which include information asymmetry as to the basic benefits of energy efficiency and the extensive cost to undertake deep retrofit measures. The design of public subsidy schemes in energy efficiency retrofits has been seen to affect scheme programme participation and outcomes (Bird and Hernandez, 2012)[10] (Collins and Curtis, 2018)[11] (Hoicka et al, 2014)[12].

The goal of this paper is to attempt to collate how much the Irish Government has invested in supports for households who wish to upgrade the energy efficiency of their home and to gauge the effectiveness of these supports, while also considering their sustainability. The paper is laid out as follows:

- Section 2 details the level of state intervention in this policy area and examines expenditure and take-up trends across the various energy efficiency measures;

- Section 3 assesses the effectiveness of these incentives relative to their stated objectives by looking at the extent to which supports have influenced purchasing decisions;

[8] SEAI, 2015, Unlocking Ireland's Energy Efficiency Potential
[9] M. Collins and J. Curtis, "An examination of the abandonment of applications for energy efficiency retrofit grants in Ireland," Energy Policy, vol. 100, pp. 260-270, 2017.
[10] Bird, S. and D. Hernandez, 2012. "Policy Options for the Split Incentive: Increasing Energy Efficiency for Low-Income Renters", *Energy Policy*, Vol. 48, pp. 506-514.
[11] Collins, M., Dempsey, S., and Curtis J. 2018. "Householder Preferences for the Design of an Energy Efficiency Retrofit Subsidy in Ireland. The Economic and Social Review. 49 (2): pp. 145-172.
[12] Hoicka, C. E., P. Parker and J. Andrey, 2014. "Residential Energy Efficiency Retrofits: How Program Design Affects Participation and Outcomes", *Energy Policy*, Vol. 65, pp. 594-607.

- Section 4 assesses the impact of these policies on wider decarbonisation objectives;

- Section 5 considers the sustainability of the incentives over the medium term, evaluates options to improve their cost effectiveness and provides some areas for consideration.

2. Incentives for Investment in Residential Energy Efficiency

The positive externalities associated with pollution abatement result in suboptimal levels of private households undertaking energy efficiency measures. Since retrofits have environmental benefits that can't be captured by any one individual and since greenhouse gas emissions are insufficiently priced by the market, rates of energy efficiency take-up fall below the optimal level from a societal perspective. This is a clear market failure. Economic theory suggests that Government policy should be employed to help correct for such situations.

However, even aside from the externality argument, there are justifications for Government support for energy efficiency. In particular, Ireland faces legally binding EU targets for decarbonisation and renewable energy use. By 2020 Ireland is required to have reduced greenhouse gas emissions by 20% as compared to 2005 levels, while achieving 16% renewable energy use in the economy. Improving the efficiency with which energy is used, helps to meet both of these targets, and also contributes to meeting the non-binding EU efficiency target of 16% by 2020.

Additionally, outside of energy and emissions savings, energy efficiency can bring multiple benefits to wider society, such as improving the sustainability of the energy system, the promotion of environmental goals and supporting strategic objectives for economic and social development. Government supporting market development for technologies and services required for a long-term transition has the potential to build skills, reduce costs, and promote economic activity and support innovation and jobs.

There is also a strong link between high quality housing and improved health, wellbeing and comfort. Householders also have the opportunity to experience significant financial savings as a result of energy efficiency. Homes become cheaper to run as a result of lower energy bills, which assists in alleviating energy poverty. A warmer, more comfortable home leads to improved health and wellbeing for both the young and elderly through improving internal dwelling temperatures. Investing in energy efficiency also improves the value of the home, so the homeowner can experience improved asset value.

2.1 Schemes under Review

1. Better Energy Homes Scheme

SEAI is responsible for administering the Better Energy Homes (BEH) grant scheme in Ireland. Originating as the Home Energy Savings Scheme in March 2009, its purpose is to provide grant support to home owners who can leverage the grant with their own funds to improve the energy efficiency of

their home. Grants are available for roof and attic insulation, one of three types of wall insulation (cavity insulation, external wall insulation or internal dry-lining), two types of heating system upgrade (heat pumps or heating controls upgrade only) and solar collector (panel or tube) installation.

The table below illustrates the specific grants available under the scheme:

Table 1. Grants under the Better Energy Homes Scheme (2020)	
Roof/Attic Insulation	A grant of €400 for the homeowner to improve the insulation of the home through the installation of attic/rafter insulation
Wall Insulation	- €400 for Cavity Wall Insulation - €2,750/€4,500/€6,000 for External Wall Insulation - €1,600/€2,200/€2,400 for Internal Wall Insulation
Heating System Upgrades	- €600 for air-to-air Heat Pump System - €3,500 for air to water Heat Pump System - €3,500 for ground source Heat Pump System - €3,500 for water source Heat Pump System
Heating Controls	A grant of €700 for heating control installation
Multiple Upgrade Bonus	- Additional €300 grant for the third energy efficiency measure taken - Additional €100 grant for the fourth energy efficiency measure taken

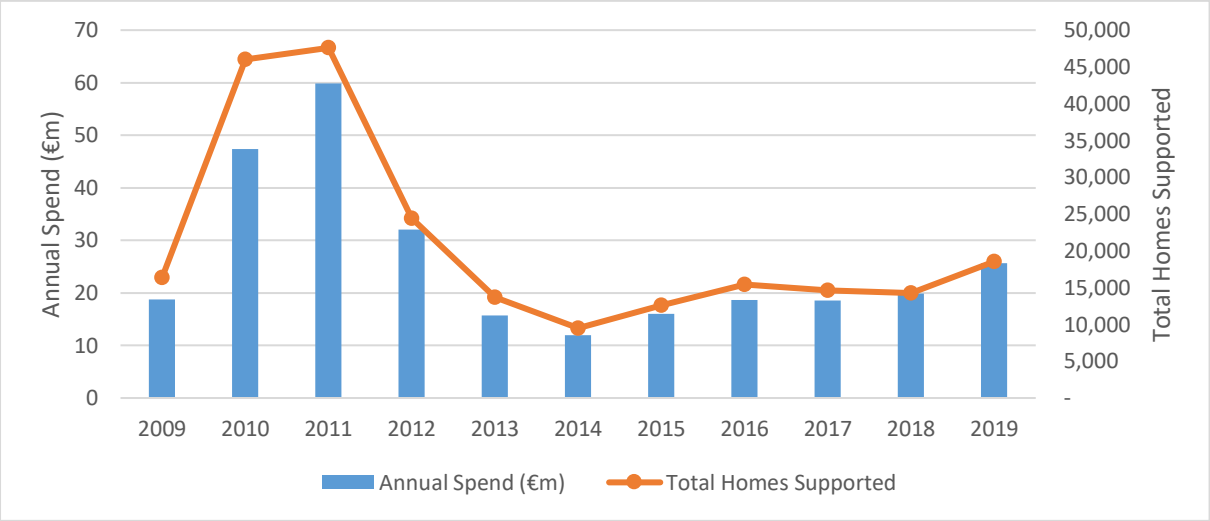
The level of grant support available under the scheme has changed over time. Prior to 2017, the grants amounted to approximately 35% of the estimated cost of each eligible measure (Collins and Curtis, 2017b)[13]. Due to inflation, SEAI estimate grant level to be approximately 28% of the cost of eligible measures.

The scheme is demand led and it is therefore difficult to predict the future spend with a high degree of certainty. The trend over the last number of years shows that the number of retrofit measures undertaken by households fluctuates year on year. 2019, however, saw a sharp increase in the number of households installing retrofit measures, with a total of 18,531 homes applying for the BEH scheme,

[13] Collins, M. and J. Curtis, 2017b. "Value for Money in Energy Efficiency Retrofits in Ireland: Grant Provider and Grant Recipients", *Applied Economics*, Vol. 49, no. 51, pp. 5245-5267.

an increase of approximately 4,300 homes in comparison with 2018. Grant expenditure in 2019 was approximately €24 million, its highest level since 2012.

Figure 3. SEAI Better Energy Homes Grant Expenditure



Roof/Attic insulation – On average, a home loses 20-30% of its heat through its roof if it's not properly insulated (SEAI)[14]. This loss of heat not only costs the homeowner in terms of higher heating bills, but it also harms the environment through a rise in Greenhous Gas Emissions. The BEH scheme offers a grant of €400 for the homeowner to improve the insulation of the home through the installation of attic/rafter insulation.

Attic/rafter insulation is generally the most cost effective of any energy efficiency upgrade made to a home, considering the potential cost savings that can be achieved on the monthly heating bills. SEAI have presented case studies in which a four bedroom detached house with an annual heating bill of €1600 can benefit from a cost saving of €250 each year on home heating through attic insulation.

Wall insulation – A home also loses approximately 20-30% of its heat through its external walls if they are not sufficiently insulated (SEAI)[15]. The BEH provides a variety of grants for three types of wall insulation:

1) Cavity Wall Insulation – Typical costs for a Cavity wall upgrade are approximately €700-€1000 excluding a grant. The SEAI currently offer a grant of €400 for those who decide to undertake this measure. Cavity wall insulation is seen to be the best value for money of all three types of wall insulation. Dowson et al (2012)[16] measured the incentives to engage in an energy

[14] https://www.seai.ie/publications/Homeowners-Guide-To-Attic-Rafter-Insulation
[15] https://www.seai.ie/publications/Homeowners-Guide-To-Wall-Insulation.pdf
[16] Dowson, Mark, Adam Poole, David Harrison, and Gideon Susman. 2012. "Domestic UK retrofit challenge:

efficiency retrofit in the UK and find that the return on investment for a pre-1976 dwelling undertaking a cavity wall insulation is on average €2,880[17]. The SEAI also estimate that a homeowner with a four bedroom detached house could experience a cost saving of €300 on their home heating bill each year.

2) External Wall Insulation – External wall insulation is the most expensive form of wall insulation. The SEAI offer varying levels of grant support for this form of insulation, depending on the type of house undertaking this measure[18]. While external insulation is expensive, it can solve other issues such as rain penetration, poor airtightness and frost damage. However, its expense also leads to a very poor return on investment for the householder. On average, an external insulation retrofit provides a benefit that is €4,971 less than an attic and cavity retrofit (Curtis and Collins, 2017a)[19][20].

3) Internal wall insulation – While internal dry lining is a less expensive option than its external alternative, this form of insulation can be unappealing to homeowners as room space will be lost, along with kitchens, cabinets and appliances having to be refit. Similar to external insulation, the SEAI offer varying levels of grant aid depending on the type of house being retrofit[21]. While the return on investment is better than that of external insulation, opting for internal insulation also provides a benefit €1,287 less than the attic and cavity insulation retrofit.

Heating System – Inefficient heating systems are wasteful of energy, resulting in them being costly to run as a high amount of fuel is needed to maintain adequate comfort levels and hot water in the home (SEAI)[22]. Replacing an inefficient energy system with a heat pump can significantly enhance the comfort levels of a household, while also reducing running costs, energy usage and greenhouse gas emissions. However, heat pump systems are at their most effective and efficient when generating heat at a lower temperature. To install a heat pump system, the homeowner

Barriers, incentives and current performance leading into the Green Deal." Energy Policy 50: 294{305.

[17] In these studies ESRI record the lifetime of energy efficiency upgrades as 20 years, thus ROI is calculated over a 20 year period.

[18] €2,750 for an apartment/mid-terrace house, €4,500 for a demi-detached or end-terrace house and €6,000 for a detached house.

[19] Collins, M. & Curtis, J. 2017a. "Value for money in energy efficiency retrofits in Ireland: Grant provider and grant recipients". Applied Economics. 49 (51): pp 5245-5267.

[20] The ROI figures provided by Collins and Curtis (2017a) are from a purely financial perspective. Householders also tend to account for technical potential savings such as increased comfort that can lead to health and wellbeing benefits. These ROI estimates do not take these multiple benefits into account, nor do they account for the contribution towards long-term decarbonisation goals, or the economic activity generated.

[21] €1,600 for an apartment/mid-terrace, €2,200 for a semi-detached/end-terrace and €2,400 for a detached house

[22] https://www.seai.ie/publications/Homeowners-Guide-To-Heat-Pump-Systems.pdf

must first ensure that the home is already well-insulated and has low heat loss. Controls are in place so that SEAI grant-aided measures such as attic/roof insulation and wall insulation are mandatorily undertaken beforehand, as well as the double/triple glazing of windows where required. The SEAI offers grants for various types of heat pumps:

1) Air Source Heat Pumps – Common heat pump systems extract heat from external air, typically from an outdoor unit. These systems do not require underground piping to source heat and are usually cheaper and easier to install compared to the alternative ground source heat pump systems. The SEAI offers grants of €3,500 for Air to water heat pump systems and Exhaust-air to water systems. A grant of €600 is also available for an air to air heat pump system, however it should be noted that an air to air system does not provide hot water.
2) Ground Source Heat Pumps – A ground source heat pump uses the earth as a source of renewable heat. Heat is drawn from the ground through a collector pipework and transferred to the heat pump. A grant of €3,500 is available for this type of heat pump.
3) Water Source Heat Pump – These heat pumps use open water (lakes/rivers/streams) as a heat source. A grant of €3,500 is available for this form of heat pump. While water source heat pumps and ground source heat pumps can be complex and expensive in terms of installation, they can have more consistent performance than air source heat pump systems, even in colder weather.

Heating Controls

Home heating systems without heating controls can be wasteful of energy, in turn making them costly to run since there is little or no control of the amount of heat being used to heat the home and hot water. The installation of heating controls helps to accurately match space heating and water heating schedules to the homeowner's working and living patterns. Installing such heating controls will typically reduce a homeowner's energy by up to 20% (SEAI)[23].

The SEAI provide a grants of €700 for heating control installation and from an ROI perspective, it appears to be a very worthwhile investment for the householder. Collins and Curtis (2017a) estimate that the installation of heating controls offers a homeowner €270.50 more benefit than an attic and cavity wall retrofit.

[23] https://www.seai.ie/publications/Homeowners-Guide-To-Heating-Controls.pdf

Solar Energy

For heating water, thermal solar hot water systems are designed to meet a percentage of the homeowner's overall hot water requirement for the year, usually 50-60%. A solar water heating grant of €1,200 is available for the installation of either flat plate solar panels or evacuated tubes.

However, the net benefit for households installing solar energy measures is poor. Collins and Curtis (2017a) estimate that a solar retrofit offers approximately €4,871 less net benefit than that of an attic and cavity wall insulation, while also being one of the most expensive options for a homeowner.

2. Better Energy Communities Scheme

The Better Energy Communities Scheme (BEC) is one of the range of schemes operated by SEAI. This scheme funds community based partnerships to improve the energy efficiency of the building stock in their area. Upgrades can take place across all building types – homes (including those at risk of energy poverty), community facilities and businesses. By bringing together groups of buildings under the same retrofit programme, community projects facilitate community-wide energy improvements more efficiently and cost effectively than might otherwise be possible. SEAI encourages communities to engage in innovative and pioneering partnerships for delivery between sectors i.e. collaborations between public and private sectors, residential and non-residential sectors and financing entities and energy suppliers. The scheme provides support ranging from 80% for private energy poor homes, to 30% for private and public non-residential premises. Since its launch in 2012 as an area-based pilot, the Scheme has leveraged a total investment of €350 million in upgrades to 18,200 residential and 2,570 non-residential buildings.

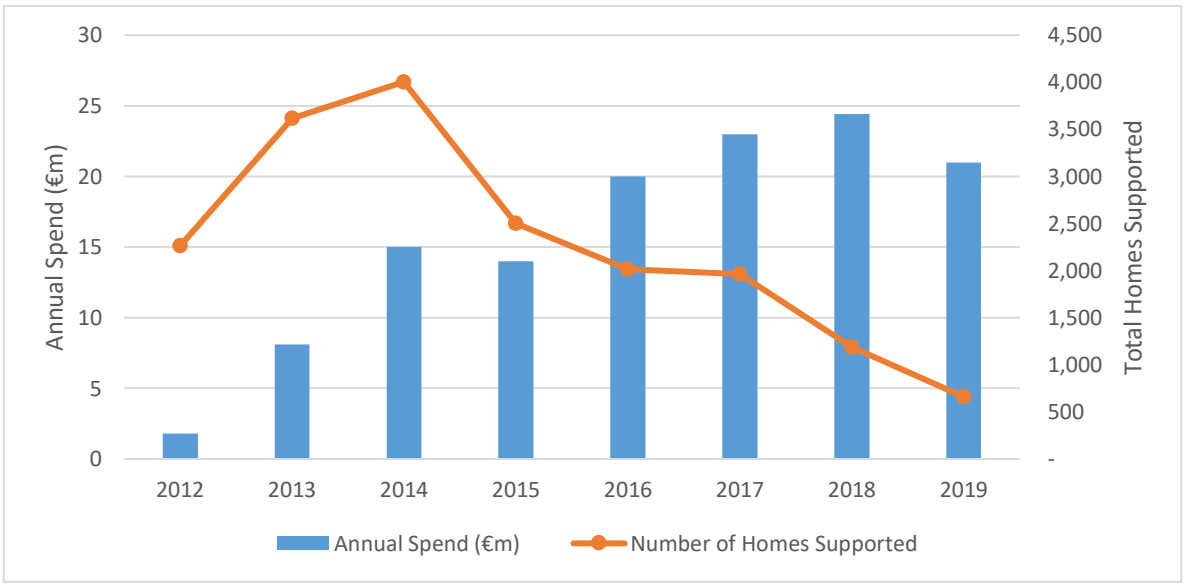
As of 2020, the maximum grant available for the CEG is €1,500,000 with no maximum project value. The SEAI offers a maximum of 50% funding per successful project which includes the project management fees. Should an application have a variety of different projects with varying funding rates, then the maximum funding rate for each project is 50%.

Some applicants can also be considered for additional augmented support if they are applying for a grant less than €200,000, are a registered Sustainable Energy Community or it is their first/second time applying for a grant. Additional supports can be provided to Assisted Community Projects at any stage pre, during and post application stage.

In 2019, the SEAI supported 57 projects under the BEC scheme with total expenditure of €25.3 million. This level of funding supports energy efficiency upgrades to 698 homes and 570 non-domestic buildings. The total project costs come to around €65.8 million. As a whole, the BEC has supported

upgrades in 18,200 homes and 2,570 non-domestic buildings, accumulating estimated CO_2 savings of 118.8KtCO2 and 479.1GWh energy savings.

Figure 4. SEAI Better Energy Communities Expenditure



3. How effective have State Supports been in encouraging Energy Efficiency Adoption?

As noted, energy efficiency contributes to the achievement of a number of critical Government priorities. The objective of introducing fiscal incentives for energy efficiency retrofits was to increase the uptake of energy efficiency, in light of the identified externalities and barriers, by lowering the upfront capital cost of the investment. This support for energy efficiency also in turn likely creates positive externalities as it exposes consumers to the benefits of a retrofit, normalises it and contributes to development of a retrofit industry. This section of the paper attempts to determine how effective the Better Energy Homes and Better Energy Communities schemes have been at achieving these objectives and quantify the benefits versus the cost to the Exchequer.

3.1 What influences Retrofit uptake?

SEAI deal with thousands of households that make energy related decisions every year. Since 2014, research findings and knowledge has been accumulated by the SEAI, focusing on consumer behaviour and decision making in the context of energy efficiency in the home[24]. Research has been gathered from consumer surveys, focus groups, design thinking exercises, pilots and trials and data analysis. Customers are asked about their experiences along their energy upgrade journey in addition to those who have not invested in theirs so that motivations, barriers and support needs are understood when it comes to the process of a residential retrofit.

At each stage of a consumer's decision making process, there are key considerations which are critical in supporting the homeowner to undertake energy efficiency measures to improve their home. Detailed analysis by SEAI shows that a consumer's decision to invest in a home upgrade is influenced by and dependent upon a series of enablers;

Consumers' Awareness and Engagement – SEAI find that the majority of owner-occupiers in Ireland consider energy efficiency measures but homeowners have different drivers influencing them to invest, or not to invest in energy efficiency. Some consumers can be aspirational, focusing on sustainability, concerned about the future and willing to adopt new measures. Others are comfort and value seekers who look to the long-term benefits and the practicality of investments made in to their home. Finally, consumers can be cost-driven, looking for purely short-term benefits such as a quick fix and immediate savings.

[24] https://www.seai.ie/publications/Behavioural-insights-on-energy-efficiency-in-the-residential-sector.pdf

Retrofit measures are elective, and some energy efficiency measures may be unfamiliar to the householder. Previous SEAI surveys have shown that while homeowners have a high awareness of measures such as attic insulation, cavity wall insulation and the replacement of windows and doors as energy efficiency measures, they have low awareness of technologies such as heat pumps, heating controls and solar PV, while homeowners also lack technical knowledge as to the benefits of these technologies. Confidence in the measures being provided to the homeowner and the quality of the work is a key factor in a homeowner's decision to renovate (or not) and should the information come from a trusted source perceived as likely to act in the homeowner's best interests and provide impartial advice, a household's engagement in the process is improved.

A key issue surrounding consumer engagement is the rental market. According to the recent Census data, 29% of households live in rented accommodation. Private landlords are less likely to invest in energy efficiency due to split incentives, where the landlord makes the capital investment but only receives a benefit where the retrofit increases the rental or re-sale value of the property. The tenant who is responsible for paying the energy bills would thus see the benefit of the work is unlikely to invest in a property that they do not own, may not be in for long, or they may not be permitted to undertake the work.

SEAI commissioned a survey to understand the key drivers of private landlords' investment in energy efficiency, finding that 75% of landlords indicated that they invest in energy efficiency to keep the property well maintained and to a good standard, with 50% of these landlords believing that these measures make tenants more comfortable and lengthen tenancies. When presented with the idea of minimum energy performance standards for rented dwellings, 50% of landlords believe that meeting the energy efficiency standards would be too costly, and that it would force them to consider the viability of remaining a landlord. Overall, 50% of all landlords cited the current grant schemes as very important in prompting energy efficiency measures on their property, increasing to 70% for those who have previously availed of a grant.

To help address the split incentive problem while being cognizant of the current accommodation shortage in Ireland, an Expert Advisory Group was established by DECC. The Group examined examples of best international practice and produced a consultation paper, including examples of approaches used elsewhere and other potential split incentive policy options for consideration. This paper formed the basis of a public consultation launched in Q4 2019, designed to inform the policy development process. The submissions made to this public consultation are currently being analysed and will assist in informing future policy.

Decision-Making Frequency and Trigger Points – Decision frequency refers to the frequency which consumers make purchasing decisions regarding their building fabric or equipment, meaning that it is a limit to the rate at which homeowners undertake energy efficiency measures. The decision frequency is related to "trigger points" at which the consumer is most likely to consider energy efficiency measures. For a deep retrofit, this might be an end-of-life replacement for the homeowner's heating system or a major building renovation for reasons outside energy efficiency. For a shallow retrofit such as draught-proofing, this trigger point may be related to minor renovations such as the redecoration of a room.

Insufficient funds and availability of finance – A lack of sufficient funding is the primary obstacle in the residential sector based on several surveys carried out in Ireland, with 70% of consumers surveyed highlighting insufficient funds as their most relevant barrier to action[25]. This becomes clear in the case for deep retrofits including external wall insulation and triple glazing of windows, where the total capital investment can reach €30,000-€40,000 for homes that start as G rated on the BER scale. Given that there are 150,000 such properties in Ireland, this will require several billion euro of capital investment.

While Government help to reduce the burden through the provision of grants through SEAI, there is no currently source of accessible and affordable finance to promote energy efficiency measures, meaning that the only households encouraged to undertake the measures are mostly those who have saved or those who have sufficient resources to afford and are willing to expend the required level of upfront costs for a retrofit. However, significant work is being done on this front through the Department of Communications, Climate Action and the Environment's Housing Retrofit Taskforce. In addition, products have been brought to market offering loans at rates of circa 5% if drawn down for the purposes of investment in energy efficiency. It remains to be seen if these interest rates will be low enough to persuade a greater number of households to invest in energy efficiency.

Consumers' Investment Behaviour – A consumer's investment choices are not solely based on the cost and the potential savings. One of the most important reasons in determining whether a consumer chooses to invest in energy efficiency is how much the energy efficiency measures improve the overall comfort of the home. A survey carried out in 2016 in Ireland also showed that grants have a 30% additional emotional impact to the consumer[26]. What this means is that each €1 of grant funding is worth €1.30 in the mind of the consumer

[25] SEAI, 2016, with Element Energy – Survey on energy efficiency loans in Ireland
[26] Element Energy for SEAI, Survey on consumers' attitudes towards energy efficiency loans in Ireland (unpublished)

Attractiveness of Government Subsidies and Programmes – SEAI have identified a number of key learnings from the various energy efficiency subsidies and programmes to improve the success and attractiveness of these programmes. How these schemes are designed and presented to consumers has a direct relationship to uptake of the scheme, an aspect which could be leveraged through the use of behavioural insights. The attractiveness of the scheme impacts the outcome at various stages over the course of the consumer's decision making journey.

The key findings by SEAI is that getting consumers to take up any retrofit options in large numbers will take time, as only a small proportion of these customers can and will avail of a low-carbon option in any given year. The relative cost of the energy efficiency upgrade options is only a consideration for consumers who are aware, prepared to act and have the budget available. However, even for motivated, aware and capable customers, the payback only makes sense for some, meaning that others may choose to invest their money elsewhere. This means that the timing of information and supports offered to consumers promoting low-carbon investments is critical.

Consumers only tend to invest in new heating sources when the existing heating source begins to fail, or invest in windows and insulation when major building works are taking place. This appears to suggest that even with the generous level of state support offered in Ireland, a large portion of consumers will not invest in low-carbon options unless other policy levers are put in place.

3.2 Global Energy Efficiency in the Residential Sector

The IEA estimates that space heating accounted for almost 50% of IEA Member countries' energy consumption in the residential sector[27]. The highest shares tend to be in European countries, with countries such as Belgium and Hungary attributing 75% of their residential energy consumption to space heating. The lowest shares are seen in Asia and Oceania, with countries such as Japan and New Zealand attributing 26% and 30% of residential energy consumption to space heating respectively.

Energy efficiency improvements for space heating have occurred across the IEA countries, primarily due to the better insulation of buildings, refurbishment of old buildings and enhancement of heating equipment. The IEA measure these effects through trends in residential space heating intensity, defined as energy consumption per floor area, which has decreased significantly in countries. For example, France, Germany and the United Kingdom have seen reductions of 30% from 2000-2017. Warmer countries such as Spain and Italy generally have lower space heating intensities, as less energy is needed on average to keep the indoor temperature at a comfortable level.

[27] https://www.iea.org/reports/energy-efficiency-indicators-2019

EU

With a consumption of 458 Mtoe in 2016, buildings account for 41% of the final energy consumption and 60% of the electricity consumption in the EU-28. Two thirds of this consumption is attributable to residential buildings (Odysee Mure, 2018)[28].

Household energy efficiency in the EU has improved by 28% in the EU with the aid with more efficient heating systems and buildings. The majority of this improvement is registered for space heating, which is falling by 2.3% per annum. Space heating is also the most important end-use of energy in the household, representing approximately 66% of total household consumption.

Energy consumption of residential buildings in the EU has shown an increase of 0.5% per annum from 2000-2008 and a decrease of 0.7% per annum from 2008-2016. As a result, energy consumption as of 2019 is slightly below its 2000 level. Two main factors are responsible for an increase in household energy consumption:

- An increase in the number of dwellings as a result of population growth and, in some countries, an increase in the number of one-person households.
- A rise in the demand for comfort characterized by an increasing number of domestic appliances and larger homes.

There is an increasing diffusion of efficient heating systems throughout the EU. For example, Italy is the leading country in Europe for heat pumps, with 75% of dwellings equipped in 2015. The next best in this category are Finland and Sweden with just over 25%. The Netherlands has the largest share of dwellings equipped with condensing boilers. The diffusion of pellet boilers and stoves instead of traditional wood heating systems also contributes to efficiency improvement. Italy is the country with the highest share of pellet boilers and stoves in Europe (115 units per 1000 dwellings) followed by Austria (51 units per 1000 dwellings), France and Germany.

The Role of Incentives

In order to overcome barriers towards the installation of retrofit measures, many countries have developed policies to encourage uptake. Outside of cash payment subsidies, taxes are one of the most popular instruments used to control energy consumption. These taxes are usually applied directly on the consumption of energy and a key advantage is that the tax revenues raised can be redirected for energy efficiency and distributional purposes. For example, the carbon tax places a direct tax on a household's consumption of fossil fuels. In addition to direct taxation, governments can also introduce

[28] https://www.odyssee-mure.eu/publications/policy-brief/buildings-energy-efficiency-trends.html

a tax deductions to boost energy efficiency investment in the residential sector. In addition to this. Some governments have also facilitated low interest loans to help finance energy efficient renovations.

In order to establish the success of these kinds of incentives, it is important to examine how these different policies have affected the uptake in residential energy efficiency measures. Several studies have been conducted as to the impacts of subsidies in various forms of rebates and subsidised loans. The majority of studies find that subsidies have a positive effect on household's choosing energy efficient appliances. In general, rebates at purchase are more effective per euro compared to subsidised loans (Markandya et al, 2015)[29].

Two of the widely discussed negatives related with rebates are free-ridership and rebound effects. Evidence of free-ridership in countries for retrofit policy has been mixed. Grosche and Vance (2009)[30] find that roughly 50% of western households in Germany presented a willingness to pay (WTP) that was higher than the observed cost for certain retrofit options. In general, international retrofit schemes generally exhibit free-riding rates from 40% to as high as 96%.

However, Collins and Curtis (2018)[31] find that only 7% of participants in the BEH scheme would have undertaken a deep retrofit even if grant funding was not offered. An additional 8% of participants would have undertaken a deep retrofit with a lower level of grant aid.

There is a vast amount of evidence suggesting that there is a significant rebound effect associated with rebates (Galaragga et al, 2013)[32]. Moreover, Alberini et al (2013)[33] find that electricity consumption for those who purchase a heat pump under a rebate does not change, whereas those who make the same purchase without a rebate experience a 16% reduction in energy consumption.

There is significant evidence to suggest that modelled energy use suggested by BER values can differ from actual energy use. The BER often overestimates the level variation in actual energy use, resulting in realised savings being less that what would have been predicted. This is often referred to as the

[29] Markandya, A., X. Labandeira and A. Ramos, 2015. "Policy Instruments to Foster Energy Efficiency", in *Green Energy and Efficiency*, pp. 93-110.
[30] Peter Grosche & Colin Vance, 2009. "Willingness to Pay for Energy Conservation and Free-Ridership on Subsidization: Evidence from Germany," The Energy Journal, International Association for Energy Economics, vol. 0(Number 2), pages 135-154.
[31] Collins, M., Curtis, J. 2018. "Willingness-to-pay and free-riding in a national energy efficiency retrofit grant scheme", Energy Policy, 118, pp. 211–220
[32] Galaragga, I., Abadie, L.M., & Ansuategi, A. 2013. "Efficiency, effectiveness and implementation of energy efficiency rebates: The "Renove" plan in Spain", Energy Economics. 40 (98): pp 98-107.
[33] Alberini, A., Gans, W., & Towe, C. 2013. "Free Riding, Upsizing and Energy Efficiency Incentives in Maryland Homes". Fondazione Eni Enrico Mattei Working Papers. Paper 835.

rebound effect. Scheer et al (2013)[34] reviewed the significance of the rebound effect in gas consumption of participants in the BEH scheme, finding a direct rebound effect of 38 ± 8%.

Italy

To incentivize households to undertake retrofit measures, Italy offer the "Ecobonus", a tax relief system that offers tax credits for the installation of energy efficient appliances. For example, Italian households are entitled to a 65% tax credit for the purchase of air conditioners with energy efficient heat-pumps, a 50% tax credit for an installation of a heat-pump system along with home renovations, a 50% tax credit on the replacement of windows/installation of shutters or a 50% tax deduction for class A condensing boilers, biomass units and solar shading.

The scheme until now has been considered to be a success. Since the start of the Ecobonus in 2007, over 3.3 million projects have been carried out, with total energy savings equating to 1.31 Mtoe/year annually. In 2017 alone, 420,000 projects were carried out, with more than half involving the replacement of windows and shutters and 20% of projects concerned the replacement of heating systems. With the help of these incentives, Italy is the European leader for heat-pump installations, with 75% of homes equipped as of 2015, and is also the leader for pellet boilers and stoves with 115 per 1000 dwellings.

Germany

The public bank KfW has been commissioned by the German government to lead programmes for improving energy efficiency since 1996. The primary goal of the successive programmes has been to provide homeowners with low-interest loans, firstly alone, then with a repayment bonus and most recently offering direct grants as an alternative to long-term financing. Since 2007, 4 million housing units have been built or refurbished, with 290,000 homes receiving an energy efficient renovation in 2016[35]. However, whilst Germany have improved significantly in terms of energy efficiency, the decline in primary energy consumption is modest at 0.25 Mtoe per annum from 2000-2016, as efficiency gains of 24.1 Mtoe have been offset by higher energy consumption resulting from economic growth, changes in lifestyle and consumption patterns as well as population growth[36].

[34] Scheer, J., Clancy, M., & Hógáin, S. N. (2013). Quantification of energy savings from Ireland's Home Energy Saving scheme: An ex post billing analysis. Energy Efficiency, 6(1), 35-48.
[35] https://www.kfw.de/KfW-Group/Newsroom/Latest-News/Pressemitteilungen-Details_403200.html
[36] https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/germany.html

France

In 2005 France launched the Sustainable Development Tax Credit (CIDD), which was a tax credit for the purchase of the most energy efficient materials. A wide range of improvements are accepted for the tax credit, namely the undertaking of insulation measures or the installation of heating regulation equipment. The cost of labour is also covered should a household install external wall insulation and ground-source heat pumps. The amount of expenses eligible for the tax credit is €8,000 for an individual and €16,000 for a couple. From 2005 until its termination in 2014, 8 million households have availed of the tax credit[37]. The CIDD has since been replaced by the Energy Transition for Green Growth Act (CITE), a tax credit amounting up to a refund of 30% of the total cost of the renovation works with the limit of €8,000 per person and €16,000 per couple.

Denmark

Denmark introduced their Better Homes scheme in January 2014, focusing on promoting the retrofit of residential buildings. The scheme created a one-stop shop within the sector, offering homeowners comprehensive expert advice throughout the renovation process so that retrofitting becomes easier and quicker. The programme focuses on developing co-operation between home-owners and financial institutions, targeting all forms of energy consumption including space heating and cooling, water heating and lighting. Specialised education is provided to professionals such as architects, engineers, craftsmen and energy consultants so that they can become advisers to homeowners on energy efficient renovation[38].

Sweden

Since 2008, owners of houses and apartments in Sweden have been able to make tax deductions for the labour costs of repairing, maintaining, rebuilding and enlargement of their dwelling. While these measures can assist in the enhancement of energy efficiency, this is not a requirement to obtain the tax deduction. In 2016 the tax deduction was lowered from 50% to 30% of labour costs and the maximum amount of aid is SEK 50,000 per person per year, which is deducted from income tax[39].

To tackle the issue of split incentives, the Swedish government has supported investment to promote energy efficiency for rental housing in areas with socio-economic challenges. This aid consists of two parts relating to renovation and energy efficiency measures. Support is only provided if projects achieve an energy efficiency improvement of at least 20% along with renovations that improve the

[37] https://www.euki.de/wp-content/uploads/2018/09/fact-sheet-energy-transition-tax-credit-fr.pdf
[38] https://ec.europa.eu/energy/sites/ener/files/dk_neeap_2017_en.pdf
[39] https://www.iea.org/reports/energy-policies-of-iea-countries-sweden-2019-review

quality of the building. The aid for energy efficiency measures is up to 5% of the total renovation cost which goes to the property owner, while the renovation aid provides 20% of the cost of the renovation which goes to the tenants of the property through a rent reduction over a seven year period.

U.K.

In 2012 the U.K. launched the Green Deal scheme, a funding mechanism based on a loan where the repayments are made through the electricity bills of the household. The loan repayments were not to exceed the energy savings assessed over the expected lifetime of the retrofit measures. The loan was also attached to the property as opposed to the owner or occupant, meaning that repayments were due by the occupant, which was a method of tackling the issue of split incentives.

However, while on paper this scheme seems attractive, the scheme was a failure, costing the exchequer a significant amount of money. Interest rates on the loans were high and unattractive to households, standing at approximately 7.9-10%. 300,259 Green Deal assessments were made, resulting in only 1,815 actual live plans. The National Audit Office in the UK concluded that the £240 million spent through the Green Deal resulted in less energy efficiency than what would've been achieved had the Government not intervened at all[40]. The Green Deal scheme was eventually scrapped in 2015 as a result of this low take-up.

Overall, the UK has experienced an emissions decrease of 6.5 Mtoe in 2017 relative to 2000, equating to a very modest 0.36 Mtoe per annum[41]. In addition to this, the installation of insulation measures under Government schemes is 95% lower than what was delivered in 2012. In order to meet their energy efficiency aspirations outlined in their Clean Growth Strategy, the average annual rate at which households undertake energy performance improvements will have to improve by a factor of seven[42].

The National Housing Stock and Energy Efficiency uptake in Ireland

Despite the supports available in Ireland for purchasing Energy Efficiency measures, the pace of adoption has generally been behind the level of ambition set out in Government targets. Since 2008, there have been a number of targets setting out the Government's ambitions for the Better Energy Homes Scheme:

[40] https://www.nao.org.uk/report/green-deal-and-energy-company-obligation/
[41] https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/united-kingdom.html
[42] https://publications.parliament.uk/pa/cm201719/cmselect/cmbeis/1730/1730.pdf

- In 2008, the aim was that the Home Energy Saving scheme (Changed to Better Energy Homes in 2011) would deliver 157Kt of CO_2 savings in the year 2020. Energy savings of 600 GWh were targeted for the years 2016 and 2020[43].
- By 2011, these targets were downsized. The revised target was 90Kt CO_2 savings for the years 2016 and 2020. Energy saving targets were 365 Gwh for 2016 and 2020[44].
- In 2017, the Government targeted total energy savings of 330 GWh between 2016 and 2020, equating to annual energy savings of 82.5 GWh[45].

Before COVID-19, Ireland was on course to reach the energy savings target set in 2017. Given the necessary reduction in activity due to public health restrictions is it unclear if this target will be reached. The BEH scheme is also significantly below the stated CO_2 savings targets in the 2011 NEEAP, having achieved just 19.2Kt CO2 savings in 2016 and averaging annual CO2 savings of 26.8Kt per annum since its inception in 2009.

As previously mentioned, the Climate Action Plan significantly increased the scale the ambition shown by Ireland in relation to residential energy efficiency. The Government have set targets for the number of buildings retrofitted to a B2 equivalent BER to approximately 500,000 by 2030 while also reaching approximately 400,000 heat pumps in existing residential buildings by 2030.

To date, over 440,000 households have taken advantage of existing Government grant schemes to make their homes more energy efficient. Of these 440,000 households, approximately 233,000 homes applied under the BEH scheme and 18,000 homes were catered for under the BEC programme. However, the vast majority of works undertaken by households have been shallow, meaning that they have not been deep enough for homes to achieve a BER-B2.

Achieving these objectives under the current models would be extremely challenging. Initial estimates from the SEAI indicate that just 1,500 retrofits to BER B2 level were completed in Ireland in 2019 (with Government Support), with approximately 1,000 existing homes installed with heat pumps. The SEAI also projected that 3,500 would be retrofit to a minimum B2 standard in 2020 in line with Government target trajectories modelled by McKinsey, with 2,000 heat pump installations.

However, these figures are now uncertain as a result of the COVID-19 pandemic. To achieve the measures set out in the Climate Action Plan, a rapid rise in the rate of retrofits and heat pump installations is essential from 2021 onwards, with some 56,215 homes having to be retrofit to a

[43] https://www.dccae.gov.ie/documents/NEEAP%201.pdf
[44] https://www.dccae.gov.ie/documents/NEEAP%203.pdf
[45] https://www.dccae.gov.ie/documents/NEEAP%204.pdf

minimum B2 standard and 50,000 homes requiring heat pump installation each year from 2024 until 2030.

The physical characteristics of Ireland's housing stock also strongly influence the residential sector's energy demand while further highlighting the issues faced in the retrofit process. 50% of the current Irish housing stock has a BER rating of D1 or lower, while only 8% are rated B2 or higher. In order to achieve the targets set out in the Climate Action Plan, 40% of homes will need to be upgraded to BER-B2 or cost optimal equivalent.

As of 2016, 42% of all dwellings in Ireland are detached houses and 45% are semi-detached/terraced houses, while just 12%of dwellings are apartments[46]. The majority of the worst performing homes by BER (F and G rated homes) are detached homes. Detached homes in general are less efficient than other dwellings due to their increased exposure to external temperatures on all sides of the home. Additionally, detached homes tend to have a much larger heated floor area. Apartments generally have the lowest levels of heat loss as a result of their lower proportion of exposed surface area in addition to their smaller size. Finally, the majority of detached homes are located in rural areas, leaving them away from the gas grid thus encouraging the use of less efficient fuels such as oil, coal and peat.

Ireland had the highest carbon emissions per dwelling in the EU between 2000-2010 and again in 2015. As of 2018, the average Irish dwelling emitted 60% more energy-related CO2 than the average EU dwelling[47]. This is primarily due to the fuel mix used in Irish households which has a high carbon intensity of fuel used, in addition to above-average energy consumption per dwelling. Ireland has a large portion of "one-off" homes, which are typically poorly insulated and heated by carbon-intensive fuels such as oil.

Whether a dwelling is located in an urban or rural area is seen to have an impact on the type of fuel and heating system is available to the household, or that they are likely to choose. In an urban setting, it may be possible to connect to the gas network or consider a district heating network[48]. However, for rural dwellings, heat pumps and biomass boilers are more likely alternatives. 64% of all households are in urban areas, while 83% of dwellings in rural areas are detached houses, compared to 19% in urban areas. Thus, a household in a rural area is likely to face significant upfront costs in order to improve their home's energy efficiency rating.

[46] https://www.seai.ie/publications/Energy-in-Ireland-2018.pdf
[47] https://www.seai.ie/publications/Energy-in-the-Residential-Sector-2018-Final.pdf
[48] Detailed modelling work will be required to determine the best pathway to net-zero emissions, given the various technology options. SEAI are conducting work to shed light on these choices.

15% of energy used in Irish households is from direct use of coal and peat, the two most carbon intensive fuels. Ireland use more of these fuels per dwelling that any other EU member state apart from Poland. 36% of energy used in Irish households is from oil, which is the highest proportion of any EU member state apart from Cyprus.

Research has shown that owner-occupiers have a greater incentive to adopt energy efficiency measures than either landlords or tenants of rented accommodation as landlords are deterred from investing due to the issue of split incentives. Over a quarter of all Irish households in 2016 were rented either privately or through a local authority, equating to roughly 450,000 dwellings. Landlords and tenants have much less of an incentive to invest in energy efficiency measures than owner-occupiers due to the issue of split-incentives. The landlord typically pays for energy efficiency works to be undertaken, but the benefits of these measures in the form of improved comfort and lower energy bills is received by the tenant of the rented property.

4. Assessing the Impact of these Policies on Wider Decarbonisation Objectives

The primary objective of incentivising energy efficiency uptake is to reduce energy use, greenhouse gas emissions and mitigate the effects of climate change. The residential stock in Ireland is highly carbon intensive and among the most inefficient in Northern Europe[49]. Thus, energy efficiency measures provide a key means of decarbonising residential heating and hence reducing residential related greenhouse gas emissions. The uptake of energy efficiency measures will also provide the homeowner with a warmer, healthier home with significant potential to make savings on their energy bill.

Several studies have shown that eliminating energy waste is the cheapest way to take carbon out of the system, which makes technologies such as insulation, glazed windows, heating controls and draught proofing essential. Heat pump systems harness energy from free renewable sources outside of the building for heating and producing hot water. The majority of Ireland's homes are heated by oil, gas and solid fuels. Through improving insulation levels and air tightness, homeowners will be in a position to change from direct fossil fuel usage to using electric heat pumps.

Grants and policy efforts run by SEAI have been integral to Ireland's emissions savings in the residential sector thus far. Between 2000 and 2016, 375,000 homes have availed of government grants for energy efficiency upgrades. However, it must also be noted that Ireland's current rate of retrofit activity is low. From 2013 to 2019, approximately 23,000 homes are retrofitted in Ireland per annum, with the majority of these works being shallow retrofits. This means that just 1.2% of the national residential building stock are undergoing retrofit activities per annum.

At this current rate of retrofitting, Ireland will fail to meet its 2020 energy reduction targets, and will also fail to reach 2030 targets unless there is a significant ramping up in scale. As previously mentioned, the Irish Government have set an ambitious target of 500,000 energy efficiency retrofits to a B2-BER or cost-optimal equivalent by 2030. If Ireland is to unlock the potential that exists for energy consumption and emission reductions within the housing stock, the rate of retrofitting needs to rise substantially. Incentives will have to target works that are essential in obtaining a B2-BER rating, as opposed to just shallow retrofit measures. The barriers to retrofitting such as such as financial and behavioural limitations, technical difficulties and information asymmetry limitations, must also be addressed.

[49] C. Ahern, P. Griffiths and M. O'Flaherty, "State of the Irish housing stock - Modelling the heat losses of Ireland's existing detached rural housing stock & estimating the benefit of thermal retrofit measures on this stock," Energy Policy, vol. 55, pp. 139-151, 2013.

4.1 Environmental outcomes of Energy Efficiency

As mentioned, upgrading to a more energy efficient home delivers several benefits not only to the homeowner, but to wider society. The analysis undertaken in this review attempts to breakdown and quantify the costs and benefits to the Exchequer of incentivising private homeowners to undertake energy efficiency measures from 2009 to 2019.

This involves using the SEAI estimates of the energy and emissions savings delivered by the schemes and monetising the CO_2 emission savings that have been achieved over the course of the BEH and BEC schemes. The values used are as per the updated Public Spending Code 2019[50]. In order to value these benefits, it is also necessary to establish a counterfactual. SEAI have calculated the relevant CO_2 and energy savings over the course of both the BEH and BEC schemes.

The costs involved in this analysis relate to direct exchequer outlays, which is the amount of funding provided by both the BEH and BEC schemes. Tables 2 and 3 show the costs to the state of incentivising energy efficiency through the BEH and BEC schemes respectively, along with the number of homes supported. Both tables are associated with the emissions savings from the schemes since their respective inceptions. Tables 3 and 4 show the breakdown of costs to the state of incentivising energy efficiency upgrades. Table 3 is based on the BEH scheme since its inception in 2009, while table 4 is based on the BEC scheme since its inception in 2012.

Table 2. SEAI Total Expenditure on BEH Scheme

Year	Annual Spend (€M)	No. Homes Supported
2009	18.8	16,344
2010	47.4	45,990
2011	59.9	47,594
2012	32	24,426
2013	15.7	13,710
2014	12	9,500
2015	16	12,612
2016	18.7	15,461
2017	18.6	14,618
2018	19.9	14,238
2019	25.7	18,531

[50] https://www.gov.ie/en/publication/public-spending-code/

Table 3. SEAI Total Expenditure on BEC Scheme		
Year	Annual Spend (€M)	No. Homes Supported
2012	1.8	2,263
2013	8.1	3,617
2014	15	4,004
2015	14	2,500
2016	20	2,013
2017	23	1,965
2018	24.4	1,188
2019	21	661

Table 4. Exchequer CBA summary of BEH and BEC Schemes			
Energy efficiency upgrades over 25 years		**BEH**	**BEC**
Costs – Exchequer Grants Paid Out		€285,000,000	€120,200,000
	Total	**€285,000,000**	**€120,200,000**
Benefits – Avoided CO_2 Emissions		€303,081,567.63	€154,752,607.47
	Total	**€303,081,567.63**	**€154,752,607.47**
NPV		€18,081,567.63	€34,552,607.47
Benefit Per Tonne of CO2 abated		€4.85	€7.57
BCR		1.0634	1.2875

When analysed in this fashion, the projected benefits of subsidising the adoption of energy efficiency measures in homes through the BEH and BEC scheme to date significantly outweigh the upfront costs. Emissions savings from retrofit activity are assumed to have a lifespan of 25 years and this plays a significant role in this outcome, along with the assumption that the shadow price of carbon will experience a significant increase from 2020 onwards, reaching a value of €198 per tonne of carbon by 2044.

The BEH scheme has saved approximately 294.4 KtCO2 since its inception in 2009, while also supporting approximately 233,000 homes[51]. The BEC scheme has saved approximately 118.8 KtCO2, supporting approximately 18,200 homes. Based on the assumptions applied in this review, the CBA

[51] Data has been provided by SEAI

indicators of Net Present Value (NPV), benefit to cost ratio (BCR) and internal rate of return (IRR) are all significantly positive.

However, it should be noted that while these CBA's have presented a net positive, aggregated data has shown that there are differing levels of performance for different measures taken. For example, retrofits undertaken by households that include solid wall insulation or solar collection have been shown to provide a much lesser net benefit, thus are more costly to the grant provider[52] [53].

Links between Current Grant Schemes and Climate Action Plan Objectives

While it is clear that the BEH and BEC schemes are delivering a net benefit to the state, a clear gap has been created between the incentives that are currently on offer through these schemes and Ireland's energy efficiency ambitions as stated in the Climate Action Plan. Prior to the Climate Action Plan, Ireland's energy efficiency targets listed in previous NEEAP's were measured in gigawatt hours of energy and kilotonnes of carbon dioxide saved. The BEH and BEC schemes were created with the overarching objective of reducing the energy usage and carbon footprint of a household so that goals outlined in the NEEAP's would be achieved.

The Climate Action Plan meant that Ireland's residential energy efficiency objectives were no longer based on a reduction in energy usage and CO2 emissions. 500,000 homes are to be retrofit to a B2 rating on the BER or the cost optimal equivalent by 2030, in addition to 400,000 heat pump installations. The BEH and BEC schemes have brought significant levels of retrofit activity since their relevant inceptions, supporting over 250,000 homes. However, the vast majority of these 250,000 elected to undertake shallow retrofit measures which have not achieved a BER-B2/CO. In 2019, just 1500 homes were upgraded to BER-B2/CO and in 2020 pre-COVID estimates forecasted just 3,500 homes to be upgraded.

Since 2019, the BEC has closer aligned itself to the Climate Action Plan targets, which resulted in a decrease in the number of homes upgraded, from 1,188 homes in 2018 to 661 homes in 2019. However, since the BEH scheme offers grant funding for individual measures taken by the household, it is not sufficient in assisting Ireland to achieve Climate Action Plan targets.

To address these issues and to further and to further improve cost effectiveness and value for money, a stronger link between these incentives and the desired outcomes is essential. The ESRI and DCCAE

[52] Collins and Curtus Value for money in Energy Efficiency Retrofits in Ireland: grant provider and grant recipients, in Applied Economics 2017

[53] Department of Communications, Climate Action and the Enrionment. Focused Policy Assessment: SEAI Better Energy Homes 2009-2015. September 2017.

have both previously recommended to explore the possibility of adjusting grant aid so that it is awarded based on the level of energy efficiency improvement gained.

5. Conclusions

Given the level of emissions caused by the national housing stock, it is evident that the State must make significant efforts to tackle the carbon intensity of the sector. Residential emissions represent approximately 10.2% of Irish emissions in the non-ETS sector as of 2018. The residential sector is the second largest emitter in terms of CO2 emissions (24%) after Transport (40%). The Environmental Protection Agency (EPA) project that residential emissions will increase by 14% to 6.5Mt CO2eq between 2018 and 2020 and are projected to decrease by 3% between 2018 and 2030 to 5.5 Mt CO2eq in the absence of additional measures[54].

Households are influenced to invest in energy efficiency upgrades through a variety of socio-economic, household specific and cost/profitability factors. Financial limitations are seen as the key barrier to a household, including high upfront costs, the availability of grants, long-term payback periods and complex funding structures. The majority of households are unaware and uninformed of the benefits that energy efficiency upgrades bring. Technical difficulties and the disruption caused by energy efficiency works also contribute towards the low rate of deep retrofit implementation. Such limitations have led to the necessity of Government intervention in order to overcome market failures that would lead to otherwise sub-optimal take-up.

Energy efficiency upgrades have long been cited as a cost effective means of addressing climate change. The IEA considers energy efficiency as a source of energy in its own right, which Ireland can invest in ahead of more complex or costly energy sources. Supportive policies come in a number of guises and are not strictly limited to grants. Countries which have been most successful in promoting energy efficiency upgrades have used measures such as low interest rate loans, tax credits and tax deductions.

Ireland has for the most part deployed a grant-based system run by SEAI and schemes have been integral towards carbon and energy savings thus far. The Better Energy Homes scheme offers grants for attic/cavity insulation, wall insulation, heat pump installation, heating controls and solar energy. Better Energy Communities encourages and funds community based partnerships to improve the energy efficiency of the building stock in their area. When accounting for greenhouse gas emissions benefits, these schemes are likely to have brought significant benefits to the State.

However, the Climate Action Plan of 2019 significantly altered Ireland's targets in relation to reducing residential emissions. Targets are now based on getting 500,000 homes to B2/cost optimal and installing 400,000 heat pumps as opposed to focusing solely on emissions reductions as seen in

[54] https://www.epa.ie/ghg/residential/

previous NEEAP's. This shift in ambition has created a clear disconnect between the incentives currently on offer through BEH and BEC, and the targets set out in the Climate Action Plan. This is particularly noticeable in the BEH scheme, where the majority of works undertaken in this scheme are shallow, meaning that very few households take the necessary measures to achieve a BER-B2 rating. In 2019 around 2,000 homes were upgraded to BER B2/Cost-Optimal. While over 23,000 homes will be retrofitted in 2020, less than 3,000 will be to BER B2/Cost-Optimal.

With the current measures in place, it would be extremely difficult to achieve over 13,000 homes to B2/CO by 2021, 34,000 homes by 2022 and 56,000 homes per annum from 2023 onwards. This level of ambition makes this one of the most challenging infrastructure projects in the history of the State. To achieve these targets, a significant scale-up in resources in terms of funding and human capital to support this increase in activity.

Grant funding alone will not be sufficient to achieve the targets set out in the Climate Action Plan. While supportive policies will play a crucial role in ensuring that households take up deep retrofit measures, these policies come in a number of guises and are not limited to grant funding. Countries such as Italy and France have been successful in encouraging deep retrofit measures through tax relief systems. Germany encourage retrofit through the use of low-interest loans. Regulatory measures will also have to be considered.

Any future policy package will require initiatives that stimulate demand for deeper energy efficiency upgrades amongst private homeowners. The majority of retrofit measures undertaken by private households are shallow, cause little disruption, provide some savings and are relatively cheap to install. Demand for deeper retrofit measures is low and this can be explained by several factors such as families prioritising other interest over retrofit, disruption caused by deeper works, the administrative burden associated with grant schemes, the under-valuation of potential savings and the invisible nature of the multiple benefits of retrofit. Thus, a range of policy measures will be essential if demand is to be sufficiently stimulated in the private household market.

However, it must be noted any future policy package is likely to come at a significant cost to the Exchequer. Analysis suggests that the total investment cost of upgrading 500,000 homes to BER-B2/CO and deploying 400,000 heat pumps to existing households is likely to be significantly in excess of previous projections. Decisions will have to made on the level of Exchequer investment to support the total investment requirements and the specific policies that can maximise the impact of this expenditure.

The Climate Action Plan requires the development of a Roadmap on the optimum mix of taxation, regulatory, subsidy and financing policies to stimulate both demand and supply in the energy efficiency market for the next decade. It is anticipated that this work will be progressed as part of and alongside the review of the National Development Plan.

Quality Assurance process

To ensure accuracy and methodological rigour, the author engaged in the following quality assurance process.

- ☐ Internal/Departmental
  - ☐ Line management
  - ☐ Spending Review Steering group
  - ☐ Other divisions/sections
  - ☐ Peer review (IGEES network, seminars, conferences etc.)

- ☐ External
  - ☐ Other Government Department
  - ☐ Other Steering group
  - ☐ Quality Assurance Group (QAG)
  - ☐ Peer review (IGEES network, seminars, conferences etc.)
  - ☐ External expert(s)

- ☐ Other (relevant details)

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