[IRELAND] Better Energy Homes

(previously Home Energy Saving scheme from 2008 to 2011)

About the measure

Policy instrument	Sector	Starting date and status
Financial (grants)	**Residential**	**[2008] – [on-going]**

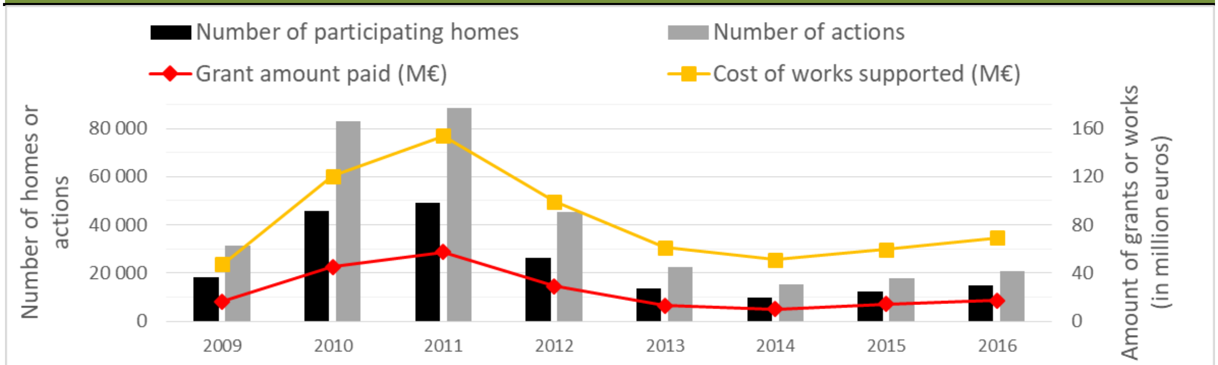
The Better Energy Homes (BEH) scheme aims at improving the energy efficiency of dwellings, reducing heating bills, CO_2 and air pollutant emissions. It is administered by the **Sustainable Energy Authority of Ireland** (SEAI) and provides direct Government **fix grants** (representing about 30% of the total investment costs) to homeowners (including landlords renting dwellings) to upgrade their **dwellings** with energy efficiency actions that must be installed by **contractors who registered with SEAI** (cf. compliance with a code of practice). Eligible action types are ceiling/attic insulation, wall insulation (both inner and outer insulation), heating controls, high efficiency boiler upgrades and solar heating systems (with minimum performance criteria and technical requirements for each action type). A **bonus grant** is available in case of **multiple actions** since 2015.

An **assessment** (Building Energy Rating) has to be **done after the works are completed**.

Actions receiving a BEH grants can also get support from an energy company within the Irish Energy Efficiency Obligation scheme (from 2014 on).

Expected energy savings in 2020	Benchmark
1324 GWh/year of final energy savings in 2020 for actions carried out between 2011 and 2020, i.e. 18% of the annual final energy savings expected in 2020 from buildings (source: NEEAP 2017, table 9)	BEH savings are not reported for EED article 7 to avoid double counting with the Energy Efficiency Obligation (EEO). In 2014-2016, about 64% of EEO savings in the residential sector came from actions receiving BEH grants.

Means and outputs



Source: data from the Better Energy Homes Activity Report (provided by SEAI)

- Number of participating homes: homes where at least one BEH action was done (192 200 distinct homes between March 2009 and August 2017, i.e. about 12% of the dwelling stock);
- Number of actions: all actions that received a BEH grant except BER (Building Energy Rating) that are not taken into account in this graph (336 900 actions for Mar2009-Aug2017);
- Grant amount paid: annual amounts of grants paid (about 213 M€ for March2009-Aug2017);
- Cost of works: material + labour costs for the BEH actions (706 M€ for March 2009-Aug2017);

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- Participants may have received financial support from energy suppliers (due to the Energy Efficiency Obligation scheme started in 2014) in addition to the BEH grant;
- Distribution of the number of actions per action type (excluding BER) for March 2009-Aug2017: 37% for roof insulation; 33% for cavity wall; 16% for high efficiency boilers with heating controls upgrade; 8% for other wall insulation; 3% for solar heating; 3% for heating controls;
- **Administration costs** were estimated to be about **6%** of the total public costs for the scheme.

Data about energy savings

Unit	Main source of data
Cumulative annual final energy savings (GWh/year)	NEEAP (based on SEAI monitoring)

Cumulative annual final energy savings: 994 GWh/year in 2016 (NEEAP 2017)

New annual final energy savings for actions installed in 2016: about 84 GWh/year (NEEAP 2017)

- **cumulative annual energy savings** = energy savings achieved in a given year from actions installed since the official start of the scheme (March 2009) and still delivering savings
- **BEH** energy savings reported by SEAI are based on the regular monitoring (see **details** below)**, do not include energy savings from boiler replacements** (that are reported for the building regulations) and are **gross energy savings**, taking into account **rebound effect** (**but not possible free-rider effects**) (see more details below)

Sources of uncertainties about energy savings

(for the deemed savings used for the regular monitoring)

- differences between ex-ante estimates (deemed savings) and actual energy savings (see below "Focus on the ex-post impact evaluation")
- use of default values for the correction factors (see below): while the factor used for rebound effect is based on observed data specific to Ireland, the factor used for free-rider effects is taken from the evaluation of another programme in the UK.

Evaluation of the energy savings

Calculation method(s) and key methodological choices

(details for the regular monitoring ; about the ex-post evaluation, see details in "Focus on…")

- standardised values of energy savings (**deemed savings**) were defined by type of action (in kWh/year.m²) based on results for 1500 dwellings observed during the pilot phase of the programme (in 2008), using **simplified engineering calculations** (based on the Building Energy Rating, **method 4**) taking into account correction factors (see below) (+these deemed savings have then been used for the Energy Efficiency Obligation scheme)
- **baseline** = average standard energy consumption before the works (per dwelling type), under normalised weather conditions (**stock average**) (+ **no energy savings reported for boiler replacements**, see above);
- factor 1 = **rebound effect**: based on the comparison between modelled and metered energy consumption, conservative values depending on the type of dwelling (values that were then refined using the results of the ex-post evaluation based on billing analysis);
- factor 2 = **free-rider (or deadweight) effects**: default value of 18% based on the evaluation of the Energy Efficiency Commitment in UK (2002-2005) done by Eoin Lees in 2006 (default free-rider effects were taken into account in the cost-benefit analysis, but are not included in the regular monitoring of the energy savings);
- double counting in national reporting is avoided by allocating energy savings per action to a given policy (for ex., savings from boiler replacement counted in building regulation).

Ex-post verifications and evaluations

The monitoring and evaluation of the BEH scheme is structured in two ways:

- a regular monitoring of each application for a grant (amount of grants approved, number and type of actions carried out, energy savings, CO2 emissions avoided and jobs supported), together with random controls (including on-site inspections);
- complementary ex-post studies: a survey of over 10 000 participants (Motherway and Halpin, 2010), a Cost-Benefit Analysis (Scheer and Motherway, 2011) and an ex-post impact evaluation about actions implemented in 2009 (Scheer et al., 2013 ; SEAI, 2013).

A study is currently reviewing the technologies supported by BEH to look at where Government support will be most effective. Results should be available by the end of 2017 with implementation of the recommendations from 2018 (NEEAP 2017).

Other indicators monitored and/or evaluated

Indicator	Explanations
Avoided CO_2 emissions	Results **based on the energy savings** (that take into account the correction factors for rebound and free-rider effects) and **using official direct emission factors** for CO_2 (published by the Energy Policy Statistical Support Unit of SEAI) weighted for the different fuels saved. Emission factor for electricity during action lifetime is adjusted to take into account the change in fuel mix used in electricity generation (i.e. greater uptake in renewables), and efficiency improvements in electricity generation. 2.4 $MtCO_2$ avoided for the reductions in CO_2 emissions cumulated over the action lifetime for actions carried out over 2008-2010, with average emissions reductions of approximately 1.5 tCO_2/year per dwelling (Scheer and Motherway, 2011) Avoided emissions of 28.77 $ktCO_2$/year for the actions installed in 2016 (NEEAP 2017)
Avoided emissions of air pollutants (NO_x, SO_x, VOCs and particulate matter)	Also based on the energy savings using average emission factors for gas, oil and solid fuel from data defined by the Environmental Protection Agency Ireland. Emission factors for electricity are derived from European Environment Agency data for Ireland. Results taken into account in the cost/benefit analysis, see below (but not published)
Employment (gross) effect	SEAI estimated that 60% of total expenditure on installations is on labour (expert word based on programme experience). Using national statistics about average industrial wages, the “BEH turnover” is then converted into full-time jobs directly supported by the scheme. For 2010, the turnover was estimated at over 72 M€, representing over 2000 full-time jobs directly supported. Effects in terms of indirect jobs are then estimated by using a conservative assumption of a multiplier effect of 1.4 (Scheer and Motherway, 2011).
Net Present Value (NPV)	Assessed through a Cost/Benefit Analysis (CBA), taking into account **3 different views**: government, participants and the whole society. According to the viewpoint, **different set of costs and benefits** were included in the analysis (see Scheer and Motherway, 2011 for more details). Main results were: - a positive societal NPV between €106 and 518 million over the action lifetime for actions installed over 2008-2010, depending on assumptions on energy prices and taking into account or not positive externalities (by monetizing reductions in CO_2 and other air pollutants emissions); - a negative NPV from government’s viewpoint of about 50 M€ for the implementation of the scheme from 2008 to 2010 (included) (taking into account grants’ costs, changes in tax revenues and a standard monetization of CO_2 savings)

Cost-effectiveness indicators	Also assessed through the CBA done in 2011, with different set of assumptions (see Scheer and Motherway, 2011 for more details). Taking into account as costs the total investment costs of the actions and as benefits the energy savings over the action lifetime (25 to 30 years for insulation actions, 20 years for boilers), using a standard scenario about energy prices' forecast (average growth of 3.07%/year) and a 4% discount rate, results showed for actions installed from 2008 to 2010 an overall benefit (savings) to the Irish economy of €0.024/kWh saved and €92 /tCO2 saved.
Satisfaction with the scheme and the contractors	Surveys among BEH participants showed a high level of satisfaction with over 95% of the participants surveyed in 2010 reporting a 'good' or 'excellent' overall experience with SEAI (Motherway and Halpin, 2010), and 90% of participants expressing satisfaction with their contractor (DCENR, 2014) (note: to be eligible for BEH, contractors have to register with SEAI)

About the CBA done in 2010, the evaluators (Scheer and Motherway, 2011) pointed that, despite all the efforts done to use the best data and methods available, a number of factors could affect the assumptions made. Sensitivity analyses were therefore conducted to deal with this uncertainty and to investigate the impact of varying key assumptions such as energy prices over time and taking into account (or not) externalities (reduction in CO2 emissions and in other air pollutants), thus producing a range of possible outcomes. The results of the different scenarios tested showed the major importance of the assumptions done on the trends in energy prices over the action lifetime.

In addition to the uncertainty about the energy savings, another important source of uncertainty about the CBA was the share of costs paid by the participants that needed to be assessed, as it was not directly monitored at that time. Monitoring has now been changed to record both, the amount of grants paid and the total investments made (including the amount of grants + the amount paid by the owners, possibly with other financial support like from energy companies due to the energy efficiency obligation scheme).

Other aspects evaluated

Potential spill-over effects were mentioned by the evaluators, but it was chosen not to include any factor to take spill-over effects into account, as they could not be evaluated.

Surveys of participants (Motherway and Halpin, 2010) indicated a range of other benefits realised as a result of energy efficiency upgrades, including: well-being, improved internal climate (increased comfort and reduced dampness) and perceived increase in the value of dwellings. However there were no quantitative evaluation of these impacts available at that time. More evidence are now available (see for ex., Stanley et al. 2016 about the increased value of dwellings having higher energy performance level). According to the survey of participants, the comfort improvement was the first tangible impact felt by households following an upgrade.

The evaluators of the CBA (Scheer and Motherway, 2011) therefore highlighted that all externalities cannot be monetised and/or included in a CBA. They warned that the results of a CBA do not provide the only basis for policy assessment and selection. These analyses need to be considered together with qualitative analysis of other costs and benefits not monetised in these calculations. About the BEH scheme, these might include for example potential job creation, increased comfort and property value, and potential health improvements.

Focus on the ex-post impact evaluation

The ex-post evaluation of actions undertaken in 2009 was focused on the two following questions:

- How much energy savings were realised by people who had made energy efficient home improvements under the BEH scheme?
- How close were the actual energy savings realised to the technical savings potential forecast when the BEH scheme was set up?

This ex-post evaluation was based on the **analysis of metered gas consumption** (at least 2 reads per year) of 2 samples: a **"participants" group** (210 homeowners who invested in actions with a BEH grant, and who made an energy assessment of their dwellings before and after the works), and a **control** group (153 928 households with similar dwellings in terms of type but who did not participate in the BEH scheme). In addition to the metered data, the BER (Building Energy Rating) database and other national statistics were also used to find data about dwellings' characteristics (in particular for matching "control" households with participants). A survey of the participants collected more detailed data related to heating demand and behaviours for further analyses.

The statistical approach used to evaluate the energy savings was based on a **difference-in-difference method** (quasi-experimental approach), comparing pre- (2008) and post-intervention (2010) heating consumption for both groups. The use of a control group was thus meant to ensure that the energy savings evaluated were related to the improvements carried out by the homeowners, and not to other factors that might affect all gas users (for example, fluctuations in usage relating to price or to extreme weather conditions). Using the difference-in-difference method means that the **baseline** is the **change in energy consumption observed for the control group** between 2008 and 2010.

Reasons for choosing the difference-in-difference method vs. other possible options were:

- *direct before–after comparisons* would have introduced bias due to significant changes in the environmental and economic conditions (significant reduction in economic activity and unusually cold weather in Ireland over the period of analysis);
- *cross-section estimators* require that the selection groups are statistically independent of the non-treatment outcome, while selection bias is likely among the participants to the scheme (for example due to higher environmental consciousness).

It should be noted that the ex-post evaluation was used to prepare a **public communication** (SEAI, 2013), showing to households the actual energy savings achieved thanks to the programme.

In parallel, **the billing data analysis was compared with the simplified engineering calculations**. The ex-post evaluation showed final energy savings of about 21% for the participants on average compared to the control group. Final energy savings per dwelling were estimated at [3 664 ± 603] kWh/year (95% confidence interval). The ex-ante estimate predicted average final energy savings per dwelling of 5 676 kWh/year, meaning ex-post results were **about 36%** (±8%) **lower**. This may be due to the effects of behavioural changes (direct and indirect rebound effects), poor initial estimates of achievable savings (for example due to ex-ante assumptions) and poorly performing equipment and potential inefficiencies in the systems installed. The evaluators thus pointed out greater comfort among the co-benefits of the energy efficiency improvements. Some of these lifestyle improvements can explain part of the gap between the ex-ante engineering estimates and the ex-post billing analysis, but not all (Scheer et al., 2013).

The **confidence interval** for the ex-post evaluation (± 603 kWh/year) represents the uncertainty range that can be assessed thanks to the statistical approach. However it **does not capture all the sources of uncertainty** (for ex., self-selection bias, see Scheer et al., 2013 for more details).

Experience feedback from stakeholders

Interview with Jim Scheer (SEAI, evaluator)

1. **What were the main reasons to do the ex-post evaluation?**

BEH is the biggest grant scheme for energy efficiency. The government therefore pays a particular attention to it. And the Public Spending Code requires that every scheme beyond a given threshold of annual public expenses shall be reviewed periodically. The first part of the evaluation (Cost-Benefit Analysis, CBA) was thus done to have an evidence base for the discussions with the Ministry of Finance, in particular about value for money and contribution to national targets. This was needed as SEAI is accountable to the government, and more generally to society.

It was then complemented by the billing analysis to measure the impacts and verify the assumptions that were identified in the CBA as key sources of uncertainty (for ex., assumptions about comfort taking). This part of the ex-post evaluation made possible to have more robust results and to be able to justify them to the Ministry.

One of the key results of the evaluation was that the energy savings impacts differed depending on the initial level of energy performance of the dwellings (based on the Energy Performance Certificates' classes). We observed higher comfort taking in dwellings that were the least energy efficient before works. This argued in favour of promoting more comprehensive renovations.

Another study is currently done to review each technology eligible to the scheme and the relevance to support it with public funds. The objective is to update the eligibility criteria and grant rates. About this, the previous ex-post evaluation would support a change from grant rates defined per technology, to grant rates that would be defined according to the overall energy performance improvement that could be monitored through the Energy Performance Certificates.

2. **How was the ex-post impact evaluation (the part with the billing analysis) used?**

The comparison between the engineering estimates and the billing analysis was used to update the standard values of energy savings per action and dwelling types used to monitor energy savings from the data registered from the grant applications.

3. **What were the lessons learnt in terms of evaluation practices?**

We faced some difficulties for the billing study to access billing data. The main issue was that for legal reasons, we had to contact participants to get their agreement to use their billing data for the evaluation (even if these data were anonymised). This took a lot of efforts and led to a smaller sample compared to the initial plan. We therefore strongly recommend to put a condition when setting the scheme to ensure the access to data, and that the legal team checks the validity of this condition. This should be possible for any grant scheme, as participants will very likely agree on this condition to be able to get the grant. This can save a lot of data collection efforts.

Another difficulty was related to matching the comparison and participants' groups. This meant to handle a lot of data, which may be technically difficult. And this also requires to be very cautious for respecting the confidentiality rules about data.

Billing data were provided by the gas grid operators. Most of them have a small staff, and the requests we send them were on top of their regular job. So efforts were also needed to involve them in the evaluation.

Overall, the whole process of data collection and processing took about 2 years.

4. **How was the evaluation work received/perceived by stakeholders (other than SEAI)?**

The ex-post evaluation was very well accepted by the Ministry. Indeed the evidence brought by the evaluation changed their perception of the scheme. There were no more questions about the rationale or interest to implement this scheme. At the opposite, the questions were about how to make the scheme grow. So evaluation needs move from justifying the scheme to understanding how to tackle the difficulties to get a higher participation.

SEAI has indeed now a team specialised in behavioural sciences. Their work aims at improving the communication about the scheme, to use the right message for the right target.

5. **What else would you like to highlight about your experience related to the evaluation of the scheme?**

Evaluation is crucial when public money is spent. This is a matter of responsibility and transparency. We need to know how much money is spent and how. And what impacts are achieved. The quality of the evaluation work is key to bring credibility for the results.

Empirical verifications represent a small budget compared to the whole budget of the scheme. Our experience with the ex-post impact evaluation is that it is really worth it.

While engineering estimates are useful to monitor the results on an on-going basis, I strongly recommend to go beyond engineering estimates. One may have fear to do an ex-post impact evaluation, because it may show smaller results than based on the engineering estimates. However this increases the robustness of the results and therefore the confidence funders can have in them. This can be combined with a Cost-Benefit Analysis to show that despite the energy savings being possibly smaller, the overall result for society remains a net benefit, when taking into account all the impacts, beyond energy savings alone.

Qualitative analysis is also essential, for example to know how the participants feel about the improvements of their dwelling. This should be combined with the quantitative impact analysis, in order to understand how to promote the scheme.

To go further

About the measure

- Official webpage about the scheme on the SEAI website:
http://www.seai.ie/Grants/Better_energy_homes/About_the_Scheme/
- Statistics regarding the program monitoring by SEAI:
http://www.seai.ie/Grants/Better_energy_homes/Better_Energy_Statistics/
- NEEAP 2017. National Energy Efficiency Action Plan for Ireland #4 2017-2020. Department of Communications, Climate Action & Environment. April 2017.
https://ec.europa.eu/energy/sites/ener/files/documents/ie_neeap_2017_ie.pdf
- Description in the MURE database:
http://www.measures-odyssee-mure.eu/public/mure_pdf/household/IRL42.PDF

References of the evaluation(s)

- Motherway, B., Halpin, T., 2010. Bringing Energy Home: Understanding how people think about energy in their homes. Report of the SEAI, September 2010.
http://www.seai.ie/News_Events/Press_Releases/Bringing_Energy_Home_Report.pdf
- Scheer, J., Motherway, B., 2011. Economic Analysis of Residential and Small-Business Energy Efficiency Improvements. Report of the SEAI, September 2011.
http://www.seai.ie/Publications/Your_Home_Publications_/Energy_Efficiency/Economic_Analysis_of_Residential_and_Small-Business_Energy_Efficiency_Improvements.45851.shortcut.pdf
- SEAI, 2013. Better Energy Homes Scheme: Impact Report – Billing Analysis.
http://www.seai.ie/Publications/Statistics_Publications/Energy_Modelling_Group_Publications/Better_Energy_Homes_Impact_Report_Billing_Analysis.pdf

Other useful references

- DCENR, 2014. Better Buildings – A National Renovation Strategy for Ireland. Department of Communications, Energy and Natural Resources.
http://ec.europa.eu/energy/sites/ener/files/documents/2014_article4_en_ireland.pdf
- Lees, E., 2006. Evaluation of the Energy Efficiency Commitment 2002-2005. Report to Defra.
- 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.
- Stanley, S., Lyons, R. C., Lyons, S., 2016. The price effect of building energy ratings in the Dublin residential market. *Energy Efficiency*, 9(4), 875-885.
- Official webpage about the Public Spending Code: http://publicspendingcode.per.gov.ie/

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