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Developing the regulation of energy efficiency of private sector housing (REEPS): modelling improvements to the target stock

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This document presents the main findings from the 2014-2015 research project into improving the energy efficiency of the private sector dwelling stock in Scotland, undertaken by Ipsos MORI Scotland and Alembic Research. The research was commissioned by the Scottish Government's Communities Analytical Services Division. The research identified the least cost methods of improving the energy performance of the poorest ranked dwellings in terms of their energy efficiency, i.e. those dwellings falling into the Bandings of E, F and G on the A to G SAP rating scale used to rate the energy performance of dwellings in Scotland.

Main Findings

- Amongst the private sector stock, 23% of the dwellings were identified through the use of Scottish House Condition Survey data as falling into Bandings of E, F and G on the A to G SAP scale used to rate the energy performance of dwellings in Scotland. This represents a total of 400,548 dwellings.
- The private sector overall performs worse in terms of its energy performance than the social sector, with the private rented sector having a higher proportion of dwellings amongst the F and G Bandings than other tenure groups.
- While 80% of all private sector dwellings are connected to mains gas, only 48% of those dwellings in the E F and G Bandings are connected, and amongst the worst group, i.e. Band G, only 19% of the dwellings are connected to a mains gas supply.
- Four policy scenarios were modelled to identify the least cost way to improve the energy efficiency of the private sector stock, and to assess the impact on various energy performance indicators:
  - Scenario 1: improving all dwellings to reach EPC Band F
  - Scenario 2: improving all dwellings to reach EPC Band E
  - Scenario 3: improving all dwellings to reach EPC Band D
  - Scenario 4: improving all target dwellings to move up one banding
- To achieve Scenario 1 would require a total investment of an estimated £18.6 million, with an average indicative cost of £627 per dwelling; Scenario 2 would cost an estimated £210.2 million, with an average indicative cost of £1,232 per dwelling; Scenario 3 would cost an estimated £1,070 million, with an average indicative cost of £2,672 per dwelling; Scenario 4 would cost an estimated £388.1 million, with an average indicative cost of £969 per dwelling.
- Scenario 1 has a mean payback period of 1.2 years, compared with 2.7 years for Scenario 2, 5.5 for Scenario 3, and 3.5 year for Scenario 4.
- Scenario 1 would produce fuel cost savings of £16.1million a year for the occupants; Scenario 2, £79.0 million; Scenario 3, £193 million; and Scenario 4, £111.6 million.
- Scenario 1 would achieve CO2e savings of 62,700 tonnes per year; Scenario 2, 361,700 tonnes; Scenario 3, 1.05 million tonnes; and Scenario 4, 605,800 tonnes.
- Scenario 1 would achieve a reduction of 204 m kWh in delivered energy annually; Scenario 2, 1273m kWh; Scenario 3, 3,569 m kWh; Scenario 4, 2,044 m kWh.

The Scottish Government
Riaghaltas na h-Alba

Introduction and methodology

In June 2013, the Scottish Government published the Sustainable Housing Strategy, which set out its commitment to consult on draft regulations that would set minimum energy efficiency standards for private sector houses, including both the owner-occupied and private rented sectors. This research was commissioned to inform that commitment.

The aim of the research was to establish the most effective ways to increase the energy efficiency of the Scottish private sector dwelling stock in EPC bands E, F and G, and to assess the impacts of improving these dwellings.

The project analysed and modelled existing data from the Scottish House Condition Survey (SHCS). It comprised three phases. The phase 1 objectives were to:

- develop a typology of the private sector housing stock in EPC bands EFG using data from the SHCS;
- identify archetypes - dwellings that would represent each typology group;
- identify the appropriate potential energy efficiency improvement measures;
- outline principles for constructing a hierarchy of measures to create packages that would reach minimum thresholds of energy efficiency;
- outline methods for determining costs of measures.

Developing the typology involved segmenting the data into similar dwellings in relation to the technical feasibility of improvement measures and likely gains in energy efficiency. Overall, 355 typology groupings were created with each representing around 1,100 dwellings on average (0.3% of the target stock).

In the second phase, the suitability and impact of various potential improvements were assessed for each archetype. Measures of impact modelled included energy efficiency (impact on SAP rating); CO2e emissions; primary and delivered energy; and cost effectiveness.

During the final phase, a number of policy scenarios were assessed using the modelled archetype data. As well as assessing the impact of individual measures, least costly packages of measures to take dwellings into the successive bandings - from Band G to Band F, from Band F to Band E, and from Band E to Band D - were identified and assessed.

Modelling the improvements

The base position of each typology group was established using data from the SHCS for each archetype. (This survey was designed to collect the data necessary to calculate SAP ratings and therefore EPC bandings.) The impact of a variety of improvement measures and a number of packages of measures was then assessed.

Overall, up to 38 potential improvement measures were assessed for each of the 355 archetypes. These improvements were collated from a wide variety of sources and encompassed insulation, ventilation, heating, hot water, space and water heating controls, renewables, and other energy saving improvement options.

Indicative capital costs for each of the improvement measures were identified usually from the Product Characteristics Database File (PCDF) that is part of the SAP software. This is the standard set of references costs used by SAP and by Green Deal assessments. Alternative sources of costs were investigated as part of the research.

Individual measures

The presence of energy saving features, the location of a dwelling, and whether a dwelling is on the gas grid are important factors in determining the applicability of improvement measures and assessing their relative effectiveness in improving energy efficiency. There is a high degree of variability across the different improvement measures in terms of their relative impact in improving energy efficiency. Some measures were cost effective but had little impact on SAP rating; certain measures were expensive yet have little impact on SAP rating.

Individual measures were modelled for all dwellings where they were possible to implement and where they would potentially increase the SAP rating. Among the 38 improvement measures, nine improvement measures had a payback period of less than three years, though these varied in the size of their impact. Those with the shortest payback period were adding a hot water tank jacket, low energy light bulbs, switching electricity tariff, loft insulation, and installing thermostatic radiator valves (TRVs).

Policy scenarios

Four policy scenarios were modelled to explore the least cost way in which to improve the energy efficiency of the private sector stock in EPC bands EFG:

- Scenario 1: improving all dwellings to reach EPC Band F
- Scenario 2: improving all dwellings to reach EPC Band E
- Scenario 3: improving all dwellings to reach EPC Band D
- Scenario 4: improving all target dwellings to move up one banding

Scenarios 3 and 4 affect more dwellings than do the other 2.

- 29,676 dwellings would be improved by Scenario 1
- 170,708 dwelling would be improved by Scenario 2

- 400,548 dwellings would be improved by Scenarios 3 and 4.

Dwellings in rural areas tend to be less energy efficient than those in urban areas. The majority of dwellings affected by Scenarios 1 and 2 would be in rural areas (67% and 59% respectively) while 42% of dwellings affected by Scenarios 3 and 4 would be in rural areas.

Overall, 19% of REEPS target stock is privately rented, but a higher proportion of private rented dwellings are in the lowest EPC band ratings of G and F. The implementation of regulations will be closely linked to the letting of private rented properties and the sale of owner occupied dwellings. Turnover rates of privately rented dwellings are higher than that of owner occupied dwellings. The private rented sector will therefore account for a vast majority of the REEPS target stock in the first few years of REEPS. After 3 years, private rented dwellings will account for 81% of dwellings in scenario 1, 67% in scenario 2 and 62% in scenario 3 and 4.

The number of dwellings to be improved and the average capital cost of improvements per dwelling drive the overall cost of each scenario:

- Scenario 1 (to reach EPC band F) would require £18.6 million
- Scenario 2 (to reach EPC band E) would require £210.2 million
- Scenario 3 (to reach EPC band D)would require £1,070.2 million
- Scenario 4 (all up one band) would require £388.1 million

The average capital cost of improvements reflects both how much each dwelling needs to be improved and the base position of the dwelling. The average cost of improvements tends to be higher for dwellings in rural areas than dwellings in urban areas across all Scenarios. This difference is most marked for Scenario 3 - £4,092 compared to £1,656. This is mainly because of the higher proportion of rural dwellings in EPC bands G and F.

Measures included

The total number and proportion of dwellings with specific measures included within packages of measures to bring properties up to different standards, varied across the scenarios. The three most common measures in each scenario were:

- Scenario 1 (to reach EPC band F): Loft insulation including top-up (18,375 or 62%), Hot water tank jacket (4,651 or 16%), Room thermostat (4,457 or 15%),
- Scenario 2 (to reach EPC band E): Loft insulation including top-up (74,369 or 44%), Low energy lighting (25,496 or 15%), Cavity Wall Insulation (24,611 or 14%),
- Scenario 3 (to reach EPC band D): Loft insulation including top-up (159,256 or 39%), Low energy lighting (135.662 or 34%), Cavity Wall Insulation (103,250 or 26%),
- Scenario 4 (all up one band): Loft insulation including top-up (133,380 or 33%), Low energy lighting (101,310 or 25%), Hot water tank jacket (62,406 or 16%).

There were some differences by rurality, particularly in relation to Scenario 3. A higher proportion of dwellings in rural areas have room in the roof insulation, floor insulation and the replacement Oil/LG Boilers in the package of measures to reach EPC band D. Low energy lighting was more commonly included in urban than in rural areas. There was very little difference in the measures included in the packages by tenure.

Capital costs

The average capital cost of improvements per dwelling reflects both how much each dwelling needs to be improved and the base position of the dwelling. Packages of improvements that make a large increase in energy efficiency are, on average, more expensive than those that make a small increase. The average cost of investments per dwelling in Scenario 1 is £627, in Scenario 2 is £1,232, in Scenario 3 is £2,672 and for Scenario 4 is £969.

The more efficient dwellings are, the more expensive they are to improve further. The average cost of improving a dwelling in band G by one band is £627 compared to £1,062 for a band E dwelling. A similar pattern is seen with regard to cost per SAP point increase - £46 for G to F, to £126 for E to D.

The average costs of improvements tend to be higher for rural dwellings as a higher proportion fall under EPC bands G and F in comparison to the overall target stock.

Impact

In terms of overall savings in relation to fuel costs, CO2e emissions and Primary and Delivered Energy consumption, Scenario 1 has the smallest impact and Scenario 3 has the largest impact due to the difference in terms of number of dwellings improved and scale of the improvements required. Generally, however, the more efficient a dwelling is pre-improvement measures, the smaller the impact of the improvements will be.

With regard to annual fuel cost savings of the different scenarios:

- Scenario 1 would give an annual fuel cost savings of £16.1 million
- Scenario 2, £79.0 million
- Scenario 3, £193 million
- Scenario 4, £111.6 million

The average impact per dwelling differs by the scale of the improvement required and the base position of the dwelling. For the least efficient dwellings, the capital cost of improvements is lowest, and the financial gains are highest. It follows that the payback period is the shortest for these dwellings. Scenario 1 has a mean payback period of 1.2 years, compared with 2.7 for Scenario 2, 5.5 for Scenario 3, and 3.5 year for Scenario 4.

Impact on CO2e emissions were estimated:

- Scenario 1 would give annual savings of 62,700 tonnes,
- Scenario 2 amounts to 361,700 tonnes,
- Scenario 3 amounts to 1.05 million tonnes,
- Scenario 4 amounts to 606,000 tonnes.

The larger the scale of the improvement measure the greater the reduction in CO2e emissions. However the level of efficiency prior to improvements does not impact CO2e emissions savings.

Impact on delivered and primary energy savings were estimated to be:

- Scenario 1 would lead to an annual saving of 204m kWh per annum for delivered energy and 306m kWh for primary energy.
- Scenario 2 leads to an annual saving of 1273m kWh for delivered energy and 1689m kWh for primary energy.
- Scenario 3 leads to an annual saving of 3569m kWh for delivered energy and 5030m kWh for primary energy.
- Scenario 4 leads to a savings of 2,044m kWh for delivered energy and 2968m kWh for primary energy.

As with energy costs, the larger the scale of improvement made, the greater the impact. Further improving a dwelling by one band has a larger impact on the least efficient dwellings.

This document, along with the full Research Report and modelling results for 355 archetype dwellings is available at http://www.gov.scot/Topics/Research/by-topic/Planning/publications. Further information about social and policy research commissioned and published on behalf of the Scottish Government, can be viewed at: http://www.gov.scot/socialresearch. If you have any further queries about social research, please contact us at socialresearch@gov.scot or on 0131-244 2111.

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