Electricity savings from window retrofitting: The "Enova Recommends" Programme

1 Summary of the program.

1..1 Short description of the program.

1..1.1 Purpose / goal of the program.

Norwegian houses from the 1960s, -70s and -80s are built with an energy quality that is considerably lower than the quality prescribed by current building regulations. This lower quality is related to the windows, general air tightness and wall insulation, and manifests itself in a relatively high heat loss and thus high energy consumption for heating. Typically, 40 % of the heat loss through the building envelope is related to the windows of these houses, in a Nordic climate. The windows of such buildings thus represent a central component to address in order to achieve energy savings and increased comfort in the homes.

The purpose of the "Enova Recommends I" programme, which focuses on windows, is to stimulate the diffusion in the retrofit market of low-energy windows. By stimulating households to choose low-energy windows instead of standard windows in a retrofit process, additional energy savings can be achieved. The Enova Recommends commenced in 2008 and has been running since.

A simple monitoring scheme for the programme has been initiated. The following market data are collected on a quarterly basis:

i) Home retrofitting activities

A sample of 1.000 households answers a survey regarding their activities on home retrofitting. Among the questions are whether they have changed windows, the energy quality of the windows, the number of windows and their size.

ii) Market data

All (or at least a large majority of) window producers in Norway report each quarter on their sales, including the sales of low energy windows. This gives a good picture of the overall market development for low energy windows.

1..1.2 What type of instruments is used?

"Enova Recommends" is based on several instruments:

1) A label

The products that are promoted in this programme are labelled "Enova Recommends". This label is used on the products and on relevant promotion materials used by the programme.

2) Technical specification of the "Enova Recommends window"

A quality specification sheet has been developed, that details which criteria that must be satisfied in order for a specific window to qualify for the label. The U-value of the window is one of those criteria.

3) Supply side participation
Windows producers that supply products according to the technical criteria of the programme may use the label and other promotions related to Enova Recommends. These activities are regulated in a contract between the producer and Enova.

4) Retailers knowledge and promotion
Windows retailers are addressed through courses and other awareness-rising activities to better promote the recommended products.

5) Household advertising
The programme is advertised through many channels with the aim of affecting the relevant decision making of the household.

6) On-line services
Enova's free phone answering service and web services are set up to facilitate the programme.

7) PR and general marketing of the programme

1..2 General and specific user category (economic sector and subgroups).
The primary target group for the programme is private households who live in houses built during the 1960 to 1980 period, and in particular those that are in a mode for major home retrofitting. These are the actors who must represent the demand side for the low-energy windows.

The supply side of the programme may also represent a barrier to success. At the onset of the programme, only a single producer was already producing window models that satisfied the technical criteria of the programme. As a result of the programme, more than 20 producers have expanded their product inventory to also include the Enova Recommends quality windows.

1..3 Technologie(s) involved.
The technology of the Enova Recommends is a window which is in accord with three main criteria: i) Energy efficiency, ii) Quality/function and iii) Availability. In addition they must be approved by the Norsk Dør og Vinduskontroll (Norwegian Door and Window control), which is a (voluntary) control system for (producers of) doors and windows.

Criterion i) refers to the U-value of the window, which should be equal to or less than 1,0. (The U-value of a standard window within the current building code can be in the range between 1,2 and 1,6. The average value is assumed to be closer to 1,6). This measurement is based on a standard size window (1,20 m x 1,20 m) and includes the whole constriction (sash and frame). This window is typically a triple pane window, of which two of the panes have an energy coating, and with an inert gas (e.g. argon) between the panes. Windows with muntins usually do not reach up this standard. Criterion ii), functionality, implies that the window must be suitable for its assumed purpose as a window without adaptation/reworking and be easy to operate and maintain. Criterion iii) means that the window should be available for purchase from outlets in most parts of Norway, and that service, spare parts and warranty assistance should be available at the same locations. Concretely this means that the producer should be able to supply the product in more than half the counties in the country.

1..4 Relevant as a Demand Response measure?

No

2 Formula for calculation of Annual Net Energy Savings

The aim of the calculation is to determine the annual savings in kWh per household of the households reporting to have purchased the recommended windows. There are no energy consumption data available for estimation of savings. We need to base the savings calculation on an assumed heating need of the individual households, and on the energy quality of the windows (deemed savings).

2..1 Formulas used for the calculation of annual net energy savings

2..1.1 Savings formula

The following notation is used:

i = individual household index, i = 1 …n

ES_i = energy saving household i, kWh per year

A_i = area of windows retrofitted household i, m^2

ΔU_i = change (abs. value of improvement) in U-value of windows household i, W per m^2 and K

$\overline{D_i}$ = average (normal) heating degree days per year, household i

E_j = heat conversion efficiency of heating system, household i

The savings formula becomes:

$$ES_i = A_i \cdot \Delta U_i \cdot \overline{D_i} \cdot \frac{1}{E_i} \cdot \frac{24}{1.000}$$

2..2 Specify calculation parameters

Norwegian homes in the target group are predominantly heated by direct electrical heating, often in combination with wood stoves. The conversion efficiency for electrical heating is close to 1, for wood stoves it is typically in the range from 50 % (old stoves) to 80 % (new efficient stoves).

An approximate normal degree days value is available for all locations in Norway. If individual household level data are not available, a weighted average value is used (weighted by population density).

The U-value for the new window is initially assumed to be 1,0. If statistics from the manufacturers indicate that the average "Enova Recommends" window is better than 1,0, then this value should be used. Assumptions with regard to the replaced window are discussed below under baseline issues.

In addition to reducing the convection heat losses, retrofitting large surfaces of windows will also have the effect of reducing the radiation heat losses of the inhabitants of the house. This implies an increase in the operational heat of the building. This could allow for a lowering of the ambient air

temperature without loss of comfort, thus increasing the savings even more. This effect is not accounted for in the formula.

2..3 Specify the unit for the energy saving calculation, for example:

The energy savings is specified per household that has replaced one or more windows.

2..4 Baseline issues

Baseline issues relate primarily to the improvement of the U-value of the old and the new window, and they are not trivial. Viewing the problem from a micro-level bottom-up perspective, we find that there are two principally different baselines:

i) Enova Recommends triggers the retrofit

This is the situation where the household would not have replaced the window(s) in absence of the programme. In this situation it is correct to define the ΔU as the difference between the U-value of the old and new windows.

ii) Enova Recommends triggers an improved retrofit

This is the situation where the household has decided to replace their windows, but where Enova Recommends windows are chosen instead of a standard window due to the existence of the programme. Here it is the difference between the standard window (U=1,6) and the Enova Recommends window (U=1,0) that defines the ΔU.

The baseline window under baseline 2 will change over time as the average market window changes, and as the building code tightens. This information is obtained by monitoring the market for windows. This implies that we have a dynamic baseline.

Surveys must be undertaken in order to reveal which of the two baselines apply for the individual households. In lack of such information a conservative figure of U=1,6 is applied to the old/alternative window.

For the heating degree days value the weighted national average is used if no individual household location data are available.

2..5 Gross to net corrections

There is no correction for double counting, free riders, technical interactions, spillover effects or rebound effect.

2..6 Normalization

No normalization has been applied

3 Input data and calculations

Thus far the only data available to evaluate the effects of this programme are limited to the a quarterly sample of 1.000 households recording:
- the number of households reporting having replaced windows
- the number of windows replaced and their size
- the number of panes in the new windows
- the age of the old windows

The weighted average number of degree days in Norway is also known (4079).

Due to some uncertainties related to data quality, no concrete energy savings result from the "Enova Recommends I" has been calculated yet.

4 GHG savings

There is no calculation of GHG savings

References