The European window energy labelling challenge

Diana Avasoo
WSP Environmental
Sweden
diana.avasoo@wspgroup.se
www.wspgroup.com

Keywords
buildings, energy, energy efficiency, EU, labelling, rating, solar heat, solar transmittance, window rating

Abstract
The energy saving potential by upgrading windows in the European existing housing stock is more than 400 TWh per year based on an average saving of 100 kWh/m^2 window area. The saving potential is twice that figure if the windows were upgraded to more energy efficient windows.

Window energy rating helps the buyers to compare windows energy performance and transform the market towards more energy efficient windows. European Window Energy Rating System, EWERS, was a SAVE project with participants from eight countries. The project resulted in full implementation of a rating system in two countries and in pilot projects in two countries. These four countries have different rating methods.

In this paper we are going to present the Swedish pilot project supported by the Swedish Energy Agency and present the energy saving potential when the energy consumption of products that are not run with electricity is becoming visible.

Why energy rating of windows?
One of the most important aims of the world community is to reduce the consumption of energy with the associated reduction in CO_2 emission; considered by many to be a vital perquisite of reducing the harmful effects of global warming. Ensuring that fenestration products are selected on the basis of optimizing their energy performance in their specific environment will have a significant impact on achieving that goal. The accumulated additional energy loss through poorly selected fenestration products, over their lifetime, is truly enormous, and any steps that can help reduce that loss must be taken as soon as possible.

The drive to assess these products energy performance is even more important after the implementation of the European Building Energy Performance Directive.

Between 2000 and 2003 we participated in a SAVE project titled European Window Energy Rating System, EWERS. The objective of this project with participants from eight countries was to develop and establish a window labelling and rating system. After three years research by eight specialists and scientists, we agreed on a formula for calculation of windows energy balance that the rating could be based on. However, this formula gives different results in Watts depending on climate. If the window installation zone is known and provided no shading is used, the window energy balance can be calculated. If the windows are sold across the country or exported, then the energy balance of window on the label will be misleading. The consumers can for example be misled when they compare an A rated window imported from a country with mild climate to a country with cold climate.

Good marketing and tutorial skills are needed before consumers can learn to identify the national energy balance of each window. Until then, consumer rating based on energy balance should be accompanied by a Health Warning:

'*valid only for the specific window configuration specified in the rating system and for climate zone xx*'.

For cross border trading it would be beneficial to have a uniform international labelling system, rather than separate national systems. The International Standards Organisation, ISO, is working on a harmonisation program for windows energy

performance. Some of the scientists that were involved in EWERS are now working in this group. It will take many years before they agree on a standard for calculation of windows energy balance. An international approach faces many obstacles, including the standardisation of testing protocols, the treatment of different product designs, and assessment of solar shading and human behaviour.

As all other ISO standards, this one will also be difficult to understand for the consumers. Windows are different from white goods and other electricity consuming products. Windows are transparent and heat is transferred wintertime from the inside to the outside and summertime from the outside to the inside. The challenge is therefore to find a simple, easy to understand and easy to compare rating system.

Existing European window energy rating systems

The conclusions of the EWERS project were that a reliable and easy to understand rating system is needed. Four out of the eight countries that participated in EWERS decided to implement and evaluate window energy rating in their countries as a pilot project and exchange experiences.

UK

In the UK, the British government, Carbon trust and the glass and window industries supported the idea of energy rating of windows at an early stage (see figure 1). Once the project was finished, the rating system was fully implemented as it was described in EWERS. A rating organisation was established, British Fenestration Rating Council, BFRC.

All details about rating procedures etc are listed on their homepage www.bfrc.org. The label is the same as the one agreed within the EWERS project.

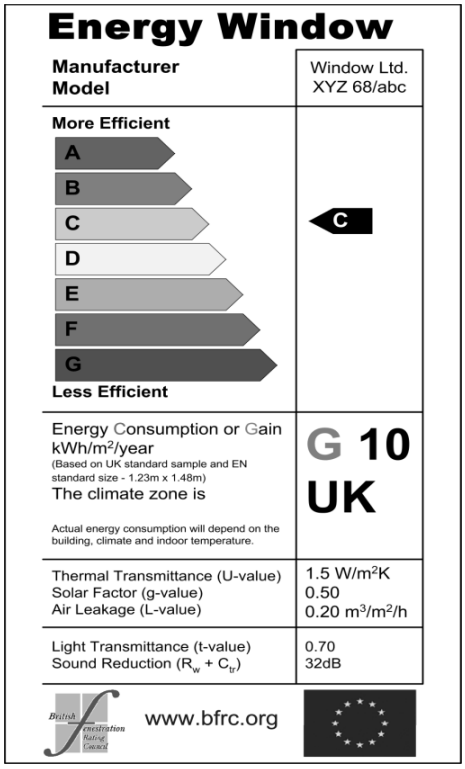

Figure 1: UK label

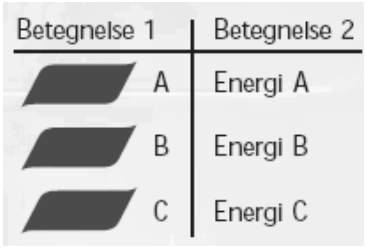

Figure 2: Danish label

Denmark

The Danish Energy Authority, Energistyrelsen, the glass industry, the glaziers' trade organisation and window manufacturer's cooperation have entered into an agreement on the phasing-out of traditional sealed units (U-value 3,0 W/m²K) and promotion of energy efficient units. The definition of "Energy efficient sealed units" in Denmark is a double glazed unit with one low emissivity (LE) glass with a U-value of ≤1,8 W/m². Consequently, energy efficient sealed units have become standard products and a campaign to promote their sales and those of energy efficient window solutions has been launched.

The Danish trade organisations and the Danish Energy Authority signed a voluntary energy labelling agreement for windows for the period 2004 until 2006. The Danish Energy Authority gave the trade more or less free hands to design the Danish energy rating system and to implement it among their members. The results are therefore much different from the outcomes from EWERS. The Danish Energy rating label differs very much from the labels used for electricity consuming products and from those used in the UK, Finland and Sweden. The label is a blue wave and the energy classification consists of only three levels, A-C (see Figure 2).

An A-rated window has a frame configuration U-value below 0,18 W/m²K and an A rated sealed unit. A B-rated window has a frame configuration U-value of 0,18 - ≤0,20 W/m²K and an A rated sealed unit. A C-rated window has a frame configuration U-value of 0,20 - ≤0,22 W/m²K and an A rated sealed unit.

1,8 is a rather high U-value for a Nordic country. The best available double glazing unit in the world market has a U-value of 1,1 W/m²K and a triple unit has 0,5 W/m²K.

The outcome of this "pilot" window and glass energy rating is under evaluation.

Finland

Finland introduced a pilot project with a slightly different calculation method for the energy balance. The label is the same as the one agreed within the EWERS project.

The project was supported by the Ministry of Trade and Industry, Ministry of the Environment, Finnish Real Estate Federation, Motiva (governmental) and the national testing institute VTT Building and Transport. After two years pilot period (2003-2005) and evaluation, the energy rating is now fully implemented. One of the important outcomes of this pilot study was: "Do not try to use the system to find out actual energy consumption of a specific window of a house. This will lead to a such complicated system which does not help buyers to select windows. If buyers don't understand the system they will not use it".

Sweden

Despite a good window standard the approximate heat loss through windows is 35. The new Swedish building regulations that are valid from July 2006, set only a maximum level of energy demand per floor area for heating, cooling, lighting etc. The building regulations for existing buildings are only advisory and contain no limitations as far as energy use is concerned. The window selection is therefore very often a matter of comparing prices. Particularly the professional buyers tend to buy the cheapest windows as they represent the builder and not the tenant who will pay the heating- and electricity bill.

In January 2006, the Swedish Energy Agency signed a voluntary agreement with ten window manufacturers. The agreement included a commitment to develop, rate, label and promote energy labelled windows during a two year period. The pilot project started officially 2006 and will be evaluated in 2008. However, the journey from ending of EWERS project until finding volunteers has been long and troublesome.

The methods that manufacturer's use for marketing their windows is not very sophisticated. Between 25 – 40 per cent rebates are offered on high tariff prices. Very often low U-values are promised but in reality the low U-value is that of the glazing unit and not the U-value of the entire window.

The window manufacturers that until now successfully sold windows to customers that were happy to receive rebate and not asking questions, were very worried when they heard about our intentions to introduce window energy rating. Suddenly the windows energy performance would be transparent. European window manufacturer's organisations contacted the European Commission already during the EWERS project protesting against energy rating of windows. During the Swedish pilot project, one international window manufacturer, afraid of the energy declaration of their windows, stopped his Swedish producer from participating in the pilot project. This shows that window energy rating and labelling is needed. The information will then be reliable, and lead to increased demand for best rated windows and hence reduce the energy consumption.

The window energy label is, as the energy labels on white goods, purely a marketing label. It communicates energy efficiency in a very simple way. You don't have to be an engineer to understand that item A is more energy efficient than item C. This part of the voluntary agreement, to use the same label as for white goods, was easy to accept by the participants. The difficult part was the rating method. Among the ten licensed window manufacturers we had two from Finland and several from Germany.

One parameter is common around the world, the U-value. The calculation method for U-value is regulated in ISO standard 10077-2 and the determination of a U-value for windows in laboratories in ISO standard 12567-1. Irrespectively of orientation, climate, window configuration etc, the U-value of a window, that is the heat transfer through a construction, is the same all over the world. We agreed then not to complicate things and to use the U-value as a rating method for windows. This was understood and appreciated by all parties. From the label shown in figure 3 you can see the rating levels set by the window manufacturers. The levels are surprisingly enough lower than the ones suggested by the project group.

Energy rate	U-value, W/m²K
A	0,9
B	1,0
C	1,1
D	1,2
E	1,3
F	1,4
G	1,5

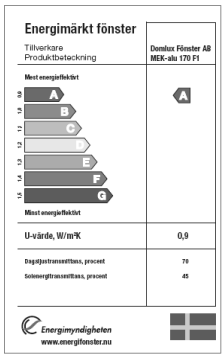

Figure 3: Swedish rating and label

Figure 4: Swedish window marking

The label shows only the U-value, the energy rate, the daylight transmittance and the solar energy transmittance. It also shows the Swedish flag. Once the project becomes permanent, the idea is that all imported windows will have a new rating based on the Swedish conditions and will obtain a Swedish flag on the label. The label can be placed on each window or printed in brochures, presented on the web site etc. The label shown in Figure 4 will be glued on the casement and is very difficult to remove. This label will make energy declaration of buildings much easier as the consultants will be able to easily identify the windows energy performance only by looking for the label.

The message to the consumers is that only labels with Swedish flag have valid energy rating in Sweden. Imported windows can obtain Swedish label after the windows energy performance has been tested or calculated by the National Testing Institute.

The project has a home page, www.energifonster.nu that consumers and other buyers can visit, calculate their energy saving, download brochures on window energy rating and be linked to window manufacturers with rated windows. Seven months after the project start, we were approached by the biggest window manufacturer in Sweden who wanted to join the pilot project. After voting we accepted to extend the project and open it for some all manufacturers that want to join in.

Market transformation

There are many ways of transforming a market towards more energy efficient products. The easiest and quickest is to give incentives such as energy grants for choosing energy efficient windows. However, this is also the most expensive one. Unless grants are not given over a long period of time, people continue to buy the cheapest windows when the grants are removed.

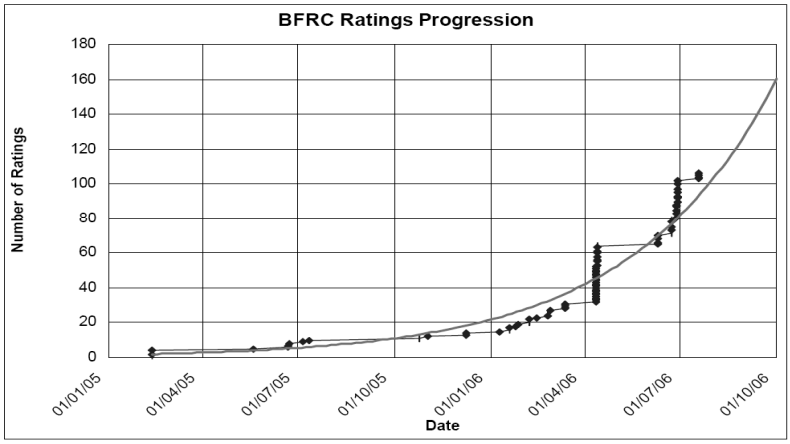

Figure 5: Energy rated windows in the UK

Energy efficient windows, units/U-value in W/m²K

Year	0,9	1,0	1,1	1,2	Comments
					Technology procurement
2000	1	16	10	20	1995
2004	1	11	11	23	Subsidies for U-value ≤ 1,2
2005	1	12	14	46	Subsidies continue
2006	7	9	23	62	Pilot project energy rating

Figure 6: Market transformation as a result of energy rating.

A second ways is by technology procurement, a long term method and suitable when the needed technology is not available on the market.

A third way, to change human behaviour through information and advice, is also a long term solution.

A fourth ways is the one we are describing here: to make energy visible. The green, yellow and red arrows show that some products are more energy consuming than others.

In the UK, after a slow start, the amount of rated windows is accelerating (figure 5).

In Sweden a technology procurement for energy efficient windows was carried out in 1991 and 1995. The winning windows had U-value of 0,8 W/m²K. Despite massive marketing efforts by the Swedish Energy Agency, very few were installed. One of the main reasons, we believe, was the manufacturer's attitude to change their production lines. The distributors found it difficult to explain the benefits of energy efficient windows or even what U-value is.

In 2004 the Swedish government introduced a grant system for windows in one-family houses. Maximum 1100 euros are granted when installing windows with U-value of 1,2 or better, for costs above 1100 euros. This incentive that now has been prolonged until 2008 stimulated production of windows with U-value 1,2 W/m²K and the availability of these increased rapidly. On the other hand, there was no ambition to develop windows with even better insulating properties.

In 2005 we hade several meetings with the Swedish window manufacturers. We informed them about our intentions to introduce energy rating for window. After the meetings, some manufacturers started to investigate the possibilities to improve their windows performance without expensive research and development. Today 11 manufacturers have joined the pilot project and rated their windows. However, many more have energy efficient windows in the rating range 0,9 – 1,5 W/m²K. Once the system becomes permanent, they will be qualified to rate their windows.

500 TWh in energy saving potential?

In Sweden, with a population of 9 million inhabitants, we identified an energy saving potential from reduced heating demand of approximately 15 TWh per year. In addition, installation of cooling is increasing rapidly. All new non-residential buildings install cooling devices. Most of the one-family houses use their heat pumps during summer for cooling. The energy savings from cooling are not included in the estimated energy saving potential.

The energy saving potential in the rest of the European countries within the union (27), with the exception of Finland, must be higher per capita. A previous study carried by Fachinformationszentrum Karlsruhe, FIZ, for the European Commission, showed that 60 per cent of the dwellings in the 15 European countries were still single glazed. Now with 12 new member

Energy losses through 1 m^2 window In Watts per 1 m^2 window		**Energy savings through 1 m^2 window In Watts per 1 m^2 window**	
Window U-value In W/m^2K		Upgrading from single glazing	Upgrading from double glazing
Single glazed	400		
Double	300	100	
Triple	200	200 *	100 *
Triple with Low E coating+argon	120	280 *	180 *

*another 5-12 % of heating costs can be reduced because possible lowering of indoor temperature due to improved indoor comfort, no downdraught etc.

Figure 7: Energy saving per m^2 window.

Solar Heat Transfer through 1 m^2 glass in Watt – Solar intensity 800 W

Glazing	Watts/m2	Index
Single	688	100
Double	608	88
Triple	544	79
Triple with solar Control Low E coating	200	29

Figure 8: Solar heat can be reduced by 71 %.

states with poor insulation standards, the energy saving potential with better insulated windows must be very high. A new study that covers both energy savings related to reduced heat losses wintertime and covers reduced cooling demand with energy efficient windows with solar control glasses is needed.

Until a new study including all 27 countries is available, we can calculate an energy saving potential based on the information we have so far. Sweden, with a rather good window standard can save 9 TWh by replacing or upgrading the existing window stock. The Swedish population is 9 millions. The energy saving potential is accordingly one TWh per one million inhabitant. We are now approximately 500 millions in EU -27.

By using the asumption above, in theory, a minimum of 500 TWh can be saved with more energy efficient windows in Europe alone.

Cooling demand

Cooling is the most accelerating energy consumption area. Energy efficient windows with solar control glasses can reduce the building heat loads from solar heat transfer by up to 70 per cent. Energy efficient windows have the potential of greatly reducing space cooling energy use in both residential and commercial buildings.

Window energy rating can be used as a tool to reduce cooling demand. The label includes information of glass heat transfer coefficient. This information can be emphasized if we, during the pilot project, receive information that the presented information is not clear enough.

Figure 8 shows that a higher awareness when designing windows in a commercial or non-residential building, can reduce the cooling demand dramatically. Modern glasses with neutral tint and with low emissivity coating provide solar shading sunny days and reduce heat losses during the heating season.

Conclusions

Windows are not quite as simple to select on the basis for their energy performance as refrigerators, pumps or automobiles. A credible, easy to understand and cost-effective window energy performance rating system can reduce the European energy consumption for heating by more than 400 TWh.

Implementation of a reliable energy rating system that is easy to understand by consumers, quickly adopted by the manufacturers is urgently needed throughout Europe if the European CO_2 emission reductions are to be met. The rating system must be monitored and controlled by independent bodies and have enough financial strength for dissemination. Houses with passive heating and cooling have been built in at least 25 years. Simple and reliable solutions exist but they are not commonly used. The results are well documented but need to be known by many more.

References

Australian Greenhouse Office, AGO. Energy Research for the Building Code of Australia. Volume 1. 2000

Australian Window Council Inc (AWC). The Australian Window Energy Rating Scheme WERS.

Canadian Standards Association and Canadian Window and Door Manufacturers' Association. Information on window labelling.

Danish Energy Agency and the energy rating element to Washington State Energy Code 1994, First Edition. April 29, 1994. programme, www.energimarkning.dk, Department of Construction and Land Use. 1994 Seattle Energy Code Supp

European Directive (2002/91/EC) on energy performance of buildings. European Commission DG-TREN.

Hemmilä, Kari, VTT Building and Transport; Härkönen, Heikki, Motiva, Finland: Agreement of method and form of labelling. Establish how to set up European Energy Rating Council.

Houses without heating system. EFEM architects, Gothenburg, University of Lund, Institution for Energy and Building Design.

National Fenestration Rating Council. Program outline and NFRC 100-SB Guidelines.