Directive 2009/125/EC
Eco-design requirements and Labelling for water heaters and hot water storage tanks
LOT 2

Statement on the Proposal of the EU Commission
and Proposal of a Suitable Procedure

Professor Dr.-Ing. Rainer Hirschberg

Status

As part of the implementation of EU Directive 2009/125/EC on the Eco-Design requirements and Labelling, the Commission submitted proposals for LOT 2 – water heaters and hot water storage tanks. Including the last published concept working document Eco-design regulation – 23 Jun 2010, this proposal still does not entail product evaluation in the factually and technically-appropriate sense. Instead, it is an evaluation based on a system evaluation which masks the properties of the product.

The procedure currently proposed by the Commission is in principle the same as in LOT 1 and does not meet the requirements for product specific energy efficiency and labelling.

There are still the same basic approaches as in LOT 1,

- building-specific parameters are used to determine the energy requirements,
- building-specific installation location is taking into account,
- building-specific heat loss of distribution systems is taken into account,
- primary energy factor is taken into account which is not part of an efficiency calculation
- the influence of smart metering is taken into account which is also not part of the efficiency of a product

A simple example for a dwelling with a ground floor of 150 m² and energy demand of 1.875 kWh/a shows the influence of the distribution (which is not a part of the product!).

In figure 1 the energy efficiency etw_{wh} is shown depended on the heat loss of the distribution system $_{Qdistr.}$ The calculation of etw_{wh} is made according to Annex VIII of the working document (Jun 2010).

From a zero heat loss of the distribution system to a possible realistic heat loss of 2000 kWh/a the influence to the so called “efficiency” is more than 60 %.

Also in figure 1 the influence of the location of the water heater is shown. If the water heater and storage tank are installed in the heated space the blue graph in figure 1 is valid instead of the red graph which shows the location in an unheated space.

Taking into account the influences in a system approach it is very easy to understand that the proposal for LOT 2 does not fulfil the minimum requirements for defining the energy efficiency of the product water heater.

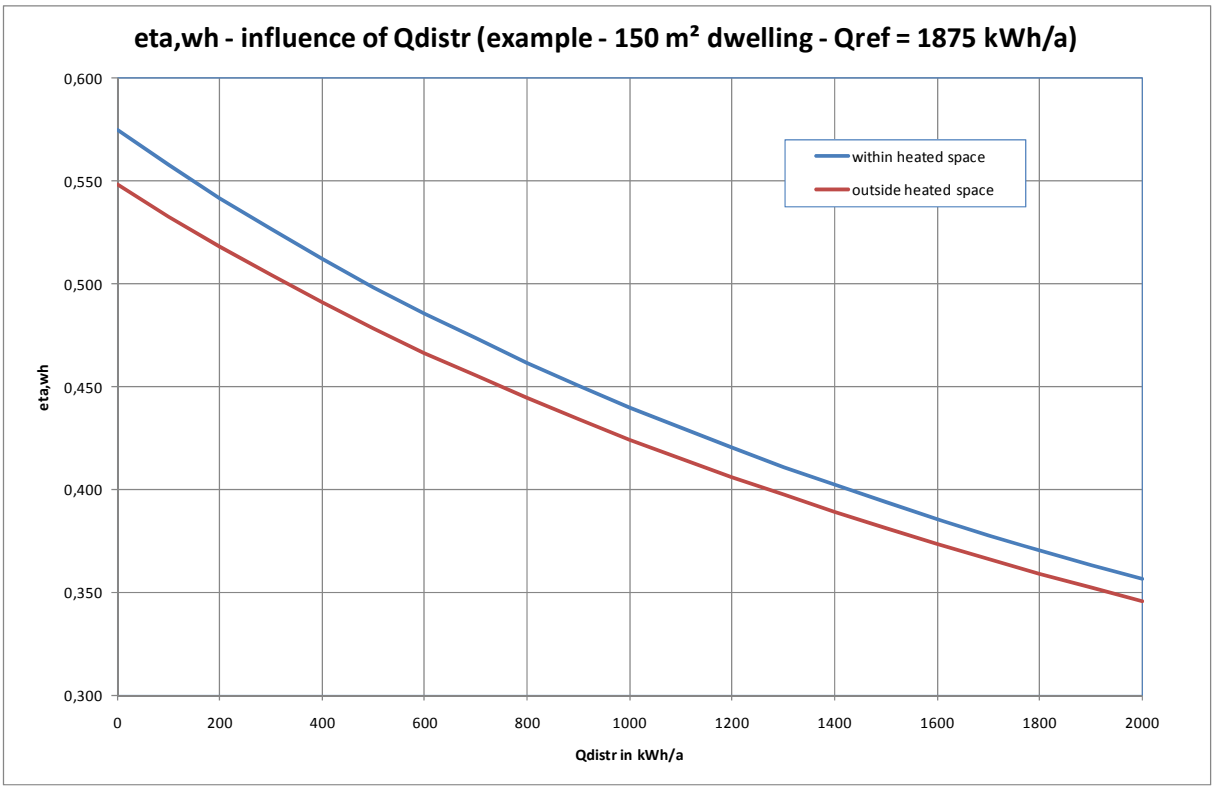

Figure 1: Example – Influence of Q_{distr} to eta_{wh}

The existing proposal of the commission does not fit the requirements of the EPBD. That means “energy efficiency” calculated according to Annex VIII cannot be used in any EPBD calculation.

Methodical approach for product evaluation

The general properties of a product can only be determined and evaluated if they are considered in isolation from the system in which they are intended to be used. This also applies for the energy evaluation and label based on this evaluation.

In terms of physical and thermodynamic aspects a water heater for domestic hot water is still only a heat exchanger. The cold water will be heated up to the defined hot water temperature and this will be done with a system that includes a storage tank or a continuous flow water heater.

In the basics of thermodynamics the effectiveness-NTU-method is very well known. This is defined as:

$$\varepsilon = \frac{\dot{Q}_{act}}{\dot{Q}_{\max}} = \frac{\text{actual heat transfer rate}}{\text{maximum possible heat transfer rate}}$$

The adaption of these basics to a method to calculate the energy efficiency is (here one has to take into account the difference between power and energy):

$$e = \frac{Q_{h,the} + Q_{h,g}}{Q_{h,out}} = \frac{\text{anual energy effort}}{\text{anual energy demand}}$$

The simple energy balance according to the equation above is shown in Figure 2.

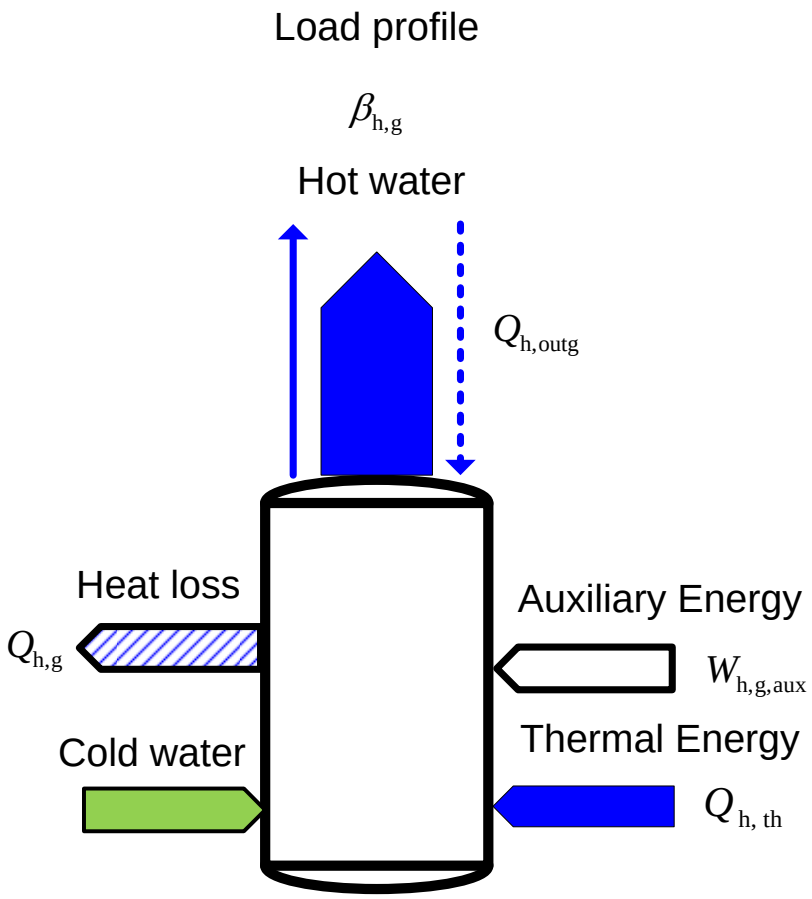

Figure 2: Energy balance on a water heater

The energy demand could be characterised by a load profile based on a tapping profile which is representing the demand of water flow and hot water temperature.

The thermal energy effort (expenditure energy) is the sum of the thermal energy for heating the water from cold water to hot water temperature and the heat loss of the water heater. The thermal energy for heating could be a mass flow from an indirect heating system (boiler, solar panel, heat pump) or from a direct heating system (electric heater rod, burner).

Using the load profile as described above, the respective expenditure ratings $e_{h,g,j}$ can be determined at four partial load levels. At the frequency of the respective partial load level h_j, the total expenditure rating results, which leads directly to a label after classification in a rating scale (see Figure 3).

This method also allows the introduction, or in particular the retention of existing test procedures, which means that no new test procedures need to be developed.

$$e_{h,g,j} = 1 + \frac{Q_{h,g,j}}{Q_{h,out,j}}$$ For j = 1 ... 4 (partial load cases)

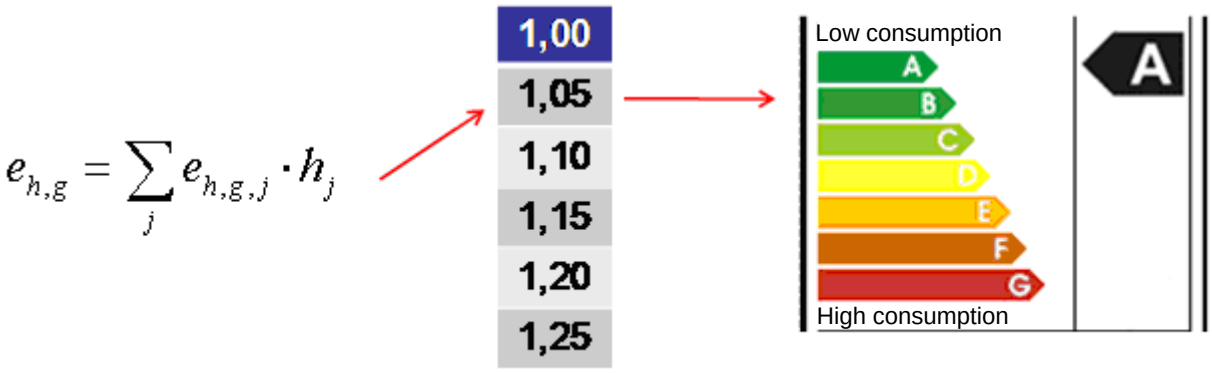

Figure 3: From the expenditure rating to a product label

The fundamental approach of the above procedure is contained in the LOT 11 – Circulators version passed by the Commission in July 2009, and thus congruent with the approaches since then.

Influence of the product quality in a heating system

Of course, knowing and evaluating the influence of the quality of a product (a component) within a real heating system is important. Knowledge of this influence is a key criterion for the investment a user has to make. It is also a key marketing criterion for installation engineers.

Therefore the same approach which the author made in the statement to LOT 1 has to be used.

Summary

The concept proposed by the EU Commission for energy evaluation of hot water heaters and hot water storage tanks in LOT 2 is physically and methodically unsuitable. The introduction of product energy labels would lead to significant legal problems as these labels would conflict with the EPBD. The methods are not compatible. New test methods to be introduced with labels which are incomprehensible to consumers are not acceptable to product manufacturers, installation engineers or consumers. Combining project properties and product properties creates barriers to trade, rather than lowering them, as the same product would have different properties in different European countries because of the installation standards. Finally, the procedure in LOT 2 is diametrically opposed to the evaluation method passed in LOT 11 in July 2009 for circulating pumps and fans.

The proposal presented here for determining energy product labels is physically correct, valid for all regions in Europe and is characterised by ease of calculation and validation by manufacturers. The responsibility for the products' energy properties remains solely with the manufacturers of the products. The general approach presented can be applied accordingly for all products in all system assemblies.

The installer who is in direct contact with the consumer can easily use the application presented in the statement to LOT 1 to evaluate the influence of a product on the energy consumption of a heating system based on real project data. This system evaluation does not contradict the EPBD in any way, nor does it lead to any methodical discrepancies which could result in a legal dispute on the quality of promised properties.

Finally, as explained in the statement to LOT 1, the same basics can be used to evaluate all system technology, so that the primary energy expenditure rating can also lead to a system label which indicates its energy quality. It also shows the influence of the use of renewable energy sources. Also, a (project-specific) system efficiency label defined accordingly does not contradict the EPBD, which incorporates the evaluation of the building.