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**LABELLING OF GAS BOILERS - AN EFFICIENT MARKET
REGULATOR**

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Abstract

This paper presents a new energy labelling scheme as a tool for choosing the right gas boiler. The impact on the boiler market after a pilot period using the scheme in Denmark is discussed.

Analyses have been made concerning:

- Development of an easy-to-use and objective evaluation tool.
- The boiler manufacturers' way of implementing the labelling system.
- Change in the configuration of the boilers (related to energy consumption).
- Development in the market of the best A labelled boilers compared to other boilers.
- The role of the gas companies in the process.
- Collaboration in the EU concerning a common EU label.

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2. BACKGROUND

An energy labelling scheme for electrical appliances (based on an EU directive) has been used in EU for more than 10 years and has been a successful tool to promote efficient appliances on the market. As no similar label was available for gas appliances, the Danish gas companies and Danish Gas Technology Centre decided to launch a similar voluntary labelling scheme for domestic gas boilers based on the same well-know existing design.

3. AIMS OF THE LABEL

The aim of the work was to give the consumer an easy-to-use and fair tool for choosing a new domestic gas boiler and thus to promote the use of high-efficient boilers. To that end we have tried to get the support from the entire gas industry in Denmark and EU. As the boilers on the Danish market are also available on other EU markets there is a wide interest for collaboration, which to a very large extent depends on the broad support of all parties concerned.

5. BASIS FOR EVALUATION

The annual efficiency (BOILSIM calculation method /1/) is the basis for the boiler labelling scheme. The advantage of this choice is that the method was developed under the European research programme (SAVE) by laboratories and manufacturers. Therefore, it is considered by many as the standard for determination of boiler annual efficiency by a large number of EU test laboratories.

Calculation algorithms for determination of an energy label for domestic gas boilers were developed. These algorithms included the parameters chosen for evaluation and the criteria set up for graduation of the boilers. It proved very helpful for the support of the boiler manufacturers that the design was following the standard from the dir. 92/75.

The arrow label graduated from A-G and with key figures with comparable information on energy utilization and environmental load of the individual boilers is meant as a decision tool for the consumer. To further assist the consumer in achieving a high sanitary hot water comfort and energy optimized operation of the heating system guidelines for choosing the best boiler/hot water tank combination were developed. Storage technology is the main market for sanitary hot water production. Figure 1 shows the template of the design of the label.

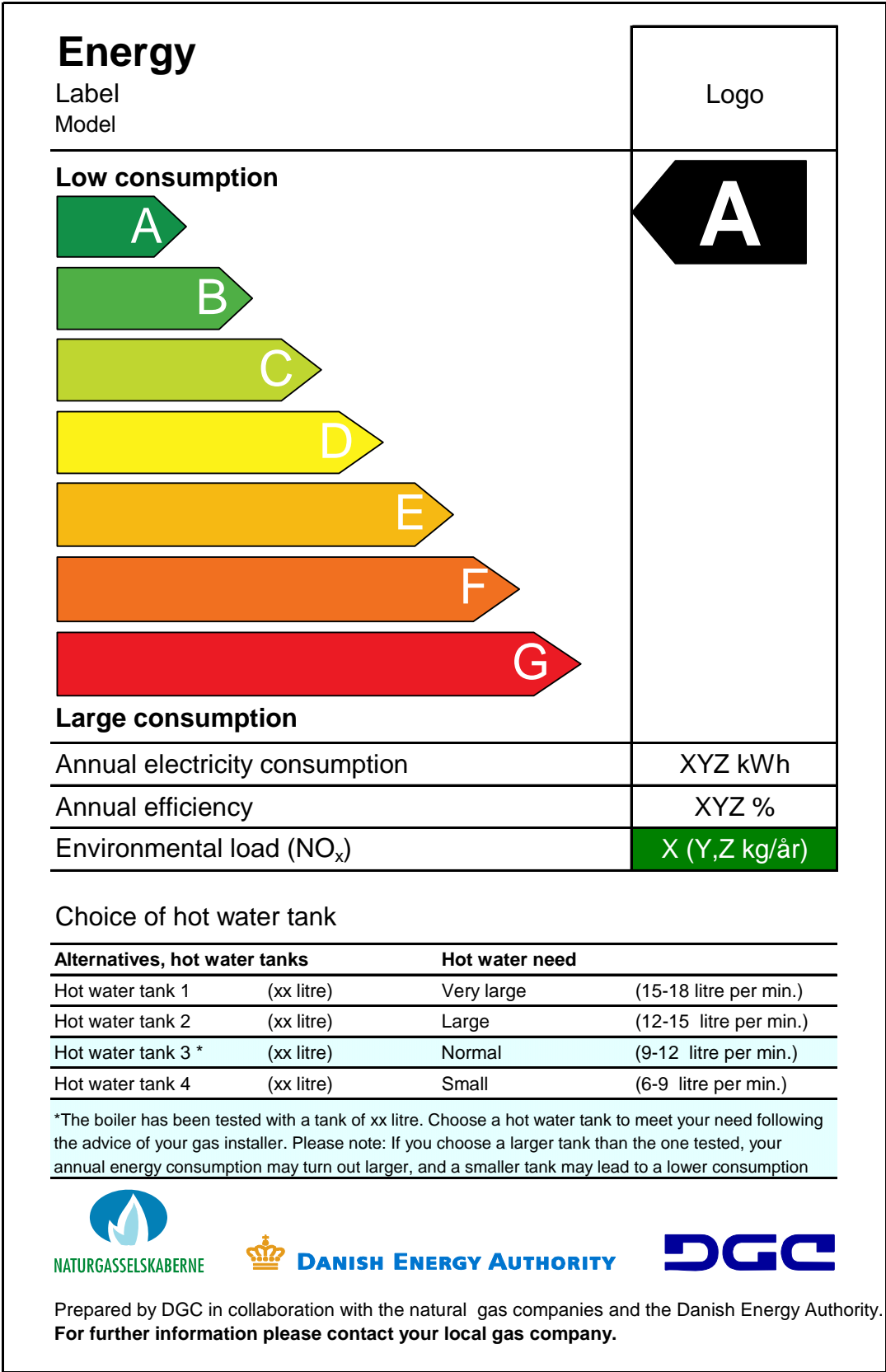


Figure 1: The template of the design of the label

Below it is described in general terms how each value of the energy label is calculated. A detailed description of the calculation method for the energy label is found in the document "Description of the calculation method for the Danish labelling of gas fired boilers" that can be downloaded from DGC's homepage.

Total annual energy consumption and the A-G label (Figure 1)

The boiler is evaluated on the basis of the total energy consumption (gas and electricity) needed to produce 20,000 kWh heat + 2,000 kWh hot water. Electricity consumption is weighted with a factor of 2.75 and the gas consumption with a factor of 1 (the ratio corresponds to a gas price of 6 DKK/m³ and an electricity price of 1.5 DKK/kWh). (The accuracy of measurements of efficiency was carefully taken into account for the design of the label.)

Weighted energy consumption	
[gas and electricity, kWh]	Energy label
< 23500	A
23500 - 24600	B
24600 - 25800	C
25800 - 27100	D
27100 - 28600	E
28600 - 30200	F
> 30200	G

Table 1: Criteria for energy labelling of boilers based on total energy consumption

Heat production

The annual efficiency of the boiler for heat production is calculated for an annual heat demand of 20,000 kWh. The calculation is based on an 8 kW heating installation, dimensioned for an average temperature on the water side of 55°C and $\Delta T = 15^\circ\text{C}$ at an outdoor temperature of -12°C . It is assumed that the boiler runs at minimum load when the heat demand is smaller than the minimum load of the boiler. The calculation of heat production is made according to the BOILSIM method.

Hot water

Annual efficiency for production of hot water is calculated for an annual consumption of 2,000 kWh, corresponding to the average consumption of Danish single-family homes.

Electricity consumption

The electricity consumption is calculated for a house with an annual heat demand of 20,000 kWh and an annual hot water consumption of 2,000 kWh. The pump is assumed to run for the entire heating season = 220 days.

Annual electricity consumption (Figure 1)

As described above for "Total annual energy consumption (section 1)".

Annual efficiency (Figure 1)

As for the calculation of total energy consumption, the boiler annual efficiency is calculated on the basis of an annual energy consumption for producing 20,000 kWh heat + 2,000 kWh hot water.

Environmental load (NO_x) (Figure 1)

NO_x emission is calculated for an annual consumption of 20,000 kWh heat + 2,000 kWh hot water, with pure methane (G20) as combustion gas.

The annual environmental load of NO_x emission is graduated on a scale from A to G based on the criteria:

- Annual NO_x emission below 1 kg/year corresponds to A
- Annual NO_x emission between 1 and 2 kg/year corresponds to B
- Annual NO_x emission between 2 and 3 kg/year corresponds to C
- Annual NO_x emission between 3 and 4 kg/year corresponds to D
- Annual NO_x emission between 4 and 5 kg/year corresponds to E
- Annual NO_x emission between 5 and 6 kg/year corresponds to F
- Annual NO_x emission over 6 kg/year corresponds to G.

Choice of hot water tank (Figure 1)

The hot water demand that can be covered by boiler and hot water tank is determined on the basis of Figure 2.

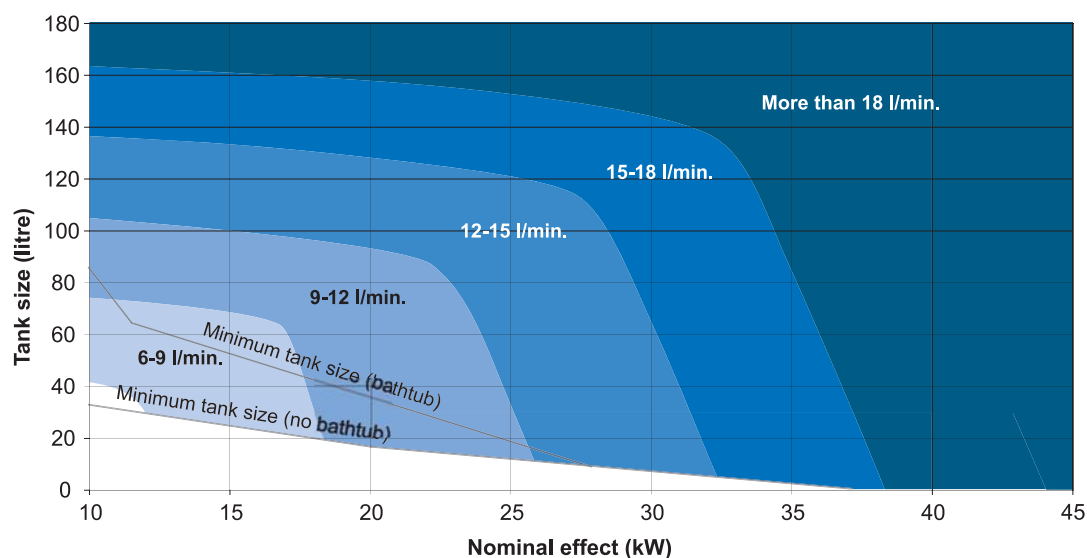


Figure 2: Criteria for choice of hot water tank

Table 2 shows the definition of the number of taps.

Hot water need	Litre per minute for 10 minutes	Corresponding to e.g.
Small	6-9	Shower
Normal	9-12	Shower and wash basin at the same time
Large	12-15	Bath tub or two showers at the same time
Very large	15-18	Two showers and wash basin at the same time

Table 2: Definition of the different categories of hot water needs

Upon adoption of the CEN standard EN 13203, the basis of calculation will be revised with the effect that the CEN standard will then form the basis of choice of hot water tank.

Apart from the label, other tools were developed that explain the contents of the label and facilitate comparison of alternative boilers. Different tools were developed for the consumer and the

installer, respectively. Boiler manufacturers are yet another target group. Apart from the above advising tools the manufacturers need to know what they are required to do in order to have their new boilers included in the labelling system.

To facilitate the implementation of the labelling scheme in the energy sector a large range of tools have been developed.

The following tools are aimed to help the end-user choose the best boiler:

- Boiler list - can be used for a quick comparison of the boilers.
- Information sheet - gives a short explanation of the individual elements of the energy label.

The following tools are aimed to help the installer, the energy adviser and the sales person to give advice concerning choice of the best boiler:

- Boiler list - can be used for a quick comparison of the boilers.
- Information sheet - gives a short explanation of the individual elements of the energy label.
- Guideline - gives a detailed explanation of the contents of the energy label.
- Presentation material - can be used for marketing.

The following tools are aimed to help the boiler suppliers and the producers:

- Administration document - describes the rules for the boiler manufacturers participating in the labelling system.
- Procedure for boiler tests - in case the boiler manufacturer wants to provide the required documentation for labelling.
- Description of calculation method - can be used by the manufacturer for determination of the energy label of the boiler.
- Market surveillance document - describes actions to prevent abuse of the energy label.

Together with the Danish gas companies and supported by the Danish Energy Agency as well as the boiler manufacturers, DGC has established a website for the boiler labelling list /2/ and an explanation in English /3/. This website also includes all the above tools. A secretariat and a steering group are in charge of administering the labelling system.

6. REPORT ON THE SITUATION AFTER A ONE-YEAR PILOT PERIOD

The implementation of the labelling scheme in the market was based on a close cooperation between DGC and the gas companies, boiler industry, Danish Electricity Saving Trust, National Consumer Agency and Danish Energy Authority. They were all prepared to support the energy labelling scheme for domestic gas boilers. The most important success criterion is that these groups would in actual fact support and use the scheme in their activities, and as will appear from the below evaluation the intentions have indeed been transformed into action.

Development of the boiler list

From the start in August 2004 the list comprised 34 boilers, of which 49 % were A labelled. During year 1 additional 14 gas boilers were accepted in the energy labelling scheme. All 14 new boilers received the A label. So a total of 72 % of the boilers on the list were A labelled.

All boiler manufacturers on the Danish market are represented on the boiler list, and the list is used by end users, installers and others who are about to compare and choose between alternative boilers.

The key figures of the energy label show a distinct trend confirming the aim of the energy labelling scheme. We draw the attention to the below points:

1. After one year, the average annual efficiency for all boilers in the list was 96 %, constituting an increase of 2 percentage points on the starting point.

2. After one year, the average electricity consumption for all boilers on the list was 477 kWh/year, constituting a decrease of 5 % on the starting point.
3. After one year, the average NO_x emission for all boilers was 1.1 kg/year against 1.3 kg/year at the start.

Development of the market

The fact that the boilers included in the labelling scheme are becoming better and better does not necessarily mean that they are the boilers that are actually being sold. In order to look into this issue the distribution of boilers sold during the first quarter of 2004 and the first quarter of 2005 was examined in two natural gas areas in Denmark. One area was the Northern part of Jutland covered by the natural gas company Naturgas Midt-Nord. The other area was the Greater Copenhagen area, covered by the natural gas company Greater Copenhagen Natural Gas.

In the Northern Jutland area 632 boilers were sold during the first quarter of 2004. 77 % of these had an A label. 16 % had no label, and the remaining 7 % had B, D and G labels. Correspondingly, 669 boilers were sold during the first quarter of 2005. 82 % of these had an A label. 11 % had no label and the remaining 7 % were B-E labelled boilers.

In other words, A labelled boilers have gained an increasing market share at the expense of non-labelled boilers.

The Greater Copenhagen area showed the same trend; however, with larger sales figures than in Jutland and with a slightly smaller share of A labelled boilers.

Similar detailed statistics are not available in the other Danish natural gas areas (Southern part of Jutland, Funen and Zealand). There is a tendency, though, that the share of condensing boilers is high and steadily increasing in these areas.

Of course, a number of parameters can be said to influence the market development in favour of A labelled boilers, but the introduction of the labelling scheme has contributed considerably. In addition, the gas industry has for several years promoted condensing gas boilers, and for quite some time now, the gas industry has been aware of the 2006 changes to the Danish Building Regulations regarding minimum requirements to boiler efficiency.

How do consumers and the energy industry use the label?

During the summer of 2005 70 new natural gas installations were inspected in a series of spot tests to check that the end user was informed of the correct energy labelling of his new boiler by means of a label attached to the gas boiler and corresponding information included in the user manual for the particular boiler.

A few boiler suppliers had already implemented the energy labelling to their product and in the user manual. However, most of the spot tests revealed that many end users were not aware of the energy label of their new boiler.

The market surveillance further included visits to Danish installer trade exhibitions and examination of campaign material. It was found that most boiler suppliers are labelling their boilers at exhibitions, and that to a great extent campaign material is including the labels and corresponding information. However, the examination revealed that for some of the boilers the campaign material only includes part of the label and leaves out the logos at the bottom of the label. In order to solve this problem, a simple arrow was developed that can be used if there is not enough room for the entire label.

Energy labelling and the new requirements of the 2006 Building Regulations

The Danish Building Regulations of 2006 introduces new requirements to gas boilers that - like the energy labelling scheme - promote the best boilers; i.e. boilers with full-load and part-load efficiencies according to the CE labelling tests of above 96 % and 104 %, respectively. This means

that in the future only condensing gas boilers will be represented in the Danish market in the case of boiler replacement as well as in the case of new buildings.

The question is, how does this relate to the labelling scheme? Will this mean that in the future only A labelled boilers meet the new requirements? The answer is No. According to DGC's database there are both B and C labelled boilers and even one D labelled boiler that fulfil the new requirements.

7. CONCLUSIONS

In the work we have developed an easy-to-use and objective evaluation tool that - based on a few key figures - can be used to compare and to choose between a number of domestic gas boilers. The tool was prepared for EU standardization.

After a one-year pilot period it appears that the energy labelling scheme has indeed influenced the boiler market:

- During this one-year period, the boiler manufacturers have adapted their boilers regarding the electrical components. Boilers that originally were sold with three-stage pumps have been modified to be sold with modulating pumps.
- The supply of the best A labelled boilers is increasing at the expense of B-G labelled boilers.
- The gas company show rooms only show A labelled boilers today.
- As the labelling system is a voluntary system, some boilers are still not labelled.

The Danish gas industry has fully supported the labelling system. The boiler manufacturers' commitment is mainly due to the fact that the labelling system has been prepared for EU standardisation. Such standardisation may in the long run result in a reduction of the number of boiler tests in the individual countries.

8. REFERENCES

1. <http://www.boilsim.com/>
2. <http://www.dgc.dk/tekniker/energimaerke.htm>
3. http://www.dgc.dk/tekniker/info_leveran.htm

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Pas photo of Karsten V. Frederiksen, main author

