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Labelling and other measures
for heating systems in dwellings

SUMMARY
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LABELLING AND OTHER MEASURES FOR HEATING SYSTEMS IN DWELLINGS

1.   Aims

The project aim is to substantially improve understanding of the EU stock of domestic heating systems, their energy-critical components (mainly boilers), and markets. The information is used to explore the scope for developing labels and other activities to promote more efficient heating systems in the EU.

Using 1995 data from Eurostat with other sources, EU15 energy consumption associated with space heating in households, including district heating, is as follows.

- Space heating energy consumption is estimated to be 6760 PJ (1880 TWh)
- Of this, at least 4470 PJ (1240 TWh) was used in central heating systems (excluding electric)
- About 66% of central heating systems (excluding electric) are also used to provide hot water, accounting for at least an additional 753 PJ (209 TWh).
- Electricity used by central heating (pumps, fans, etc.) is estimated to account for an additional 148 PJ (41 TWh). It should be remembered that carbon emissions per PJ for electricity can be about 2 or 3 times greater than for oil or gas, depending on the method of generation..

2.   Characterisation of heating systems and their markets

Data indicates that space heating energy consumption has risen very little, if at all, over the last ten years. This has occurred against a growth in households. As a result the energy/m^2 of total floor area has fallen by 30% to 40% in partner countries. There has been significant growth in central heating (from 40% to 80% between the 1970s and 1990s in France, Italy, UK), and a higher standard of heating. In the last ten to twenty years, improved heating system efficiencies and better insulation has prevented energy use from rising as a result of increasing total household floor area and improving heating standards.

Gas, oil, and electricity are the energy sources for over 90% of heating systems, though there is variation between countries. Wood is a significant fuel in Finland and Sweden (some sources indicate about 10% of households), also France and Austria. Bio-diesel is finding a market in Italy, though still marginal.

3.   Technical improvements and technological change

A ranking of heating systems was developed (which may be suitable for future for labelling purposes). A simple but versatile unit of performance was required, including both heating type, and level of comfort desired. This task aimed to establish such a method for comparing heating system performance.

Given the wide variety of heating systems in terms of fuel, heating type (room, dwelling, block, district), configuration, also climate and user operation, it was necessary to split systems into these categories:

(1) Indirect energy (electricity, district heating, co-generation) must show high efficiencies, for both electricity and heat, in order to outperform separate generation (above 40% for both).
(2) Dwelling heating systems are considered with regard to their components, that is, the boiler, distribution & emitters, control system and auxiliary electric energy use.
(3) Room heating systems are very diverse, ranging from open fireplaces and gas heaters to sophisticated electric heaters. Potential for improvement of these appears to be limited.

4.   Heating system stock model and scenarios

This task entailed the construction of a stock model for EU residential heating systems, taking into account the parameters listed in 'Technical improvements and technological change'. Due to lack of data, a dynamic and complete energy and stock model per EU member state could not be built at this stage.

However, it was possible to construct
- a detailed linear stock model of the numbers of dwelling central heating, district heating, and room heating, of each main fuel, in each EU15 country, in 1995 and 2005
- a simple method for estimating seasonal efficiency, which needs further improvement
- a first time estimated energy series for the EU15 as a whole.

The stock model is a high-quality data set for 1995 and 2005 with good consistency. Overall, it gives a good first approximation of trends to be expected, within a margin of $\pm$ 10-20% for individual segments - non-linear phenomena cause a large part of this error.

These provide the input to the scenario analysis, in which 'business as usual' and 'efficiency' scenarios of energy use to 2020 were generated. These indicated that if the efficiency of new generators sold were to increase by 10% (consistent with 50% of new boilers being as efficient as condensing boilers) by 2005, then around 80TWh could be saved by 2010 and 130 TWh by 2020. This equates to a carbon reduction of 19MtC in 2010. These should be treated as approximate estimates given the present development of the modelling (see section 8, Conclusions).

5.   Market barriers and opportunities

Efficient technologies are available based on oil and gas boilers, but their dissemination does not reflect the potential for efficiency. Policies such as subsidies and fiscal incentives have been implemented by governments to promote efficient technologies. These vary significantly between member countries. For new buildings, architects and building developers are the main actors, and their choice is influenced by energy suppliers and/or manufacturers. For existing buildings, the consumer is strongly influenced by the installer, who generally does not consider energy efficiency a first priority. Moreover the consumer usually has little information about energy use, so that in general he is unable to consider this.

The main regulations which are relevant are European Directive 92/42/EEC, which applies to liquid and gaseous fuelled boilers, and National Thermal or Building Regulations which applies to new buildings. Manufacturers are now making products of a higher energy efficiency than the minimum required in the European Directive, and it would therefore be feasible to define a new minimum level. Only a few countries have regulations concerning energy efficiency when installing or replacing boilers in existing buildings. This is particularly unfavourable to the proper sizing of a boiler, and the correct replacement of other heating system components.

A general barrier in all countries is a lack of information to the main actors, particularly to the final consumers. This is clearly a major market constraint to the uptake of efficient heating systems. Two options to overcome this are minimum efficiency standards in regulations, and information for consumers about energy consumption by means of a label. While in most EU countries heating represents the largest share of energy consumption in a building, at present there is no labelling system. Labels are in use for a variety of household appliances, and the 'A to G' scale is generally accepted and understood by EC consumers.

6.   Stakeholder impact analysis

The focus for this task was the manufacturers of heating systems. They are important players influencing the efficiency of heating appliances, and it is their market which will be affected by a labelling scheme. This work included theoretical research estimating the effect on manufacturers, and interviews. Responses to a questionnaire were received from 14 companies in 5 countries, representing more than 30 percent of the EU market. By inviting relevant market associations to a meeting and talking to their representatives the common position of the industry was also included.

Four hypotheses about the effects of a label were considered, as follows.
- Companies producing low-standard boilers could be forced from the market. Little evidence was found that this is a problem, as most companies manufacture efficient systems in their range.
- Companies which produce systems that rank lower in a labelling scheme could be affected. This would probably apply to electricity, and to a lesser extent to oil, if one single label, on a primary energy basis, for all energy sources were introduced. However, substitution of an electric heating system by a fossil-fired one requires a decision for a completely new system, and this fact will prevent radical market changes in the short and medium term. Producers of electric heat pumps, however, could also be among the winners of a labelling scheme, as our interviews showed. Energy sources such as biomass, and solar systems are also likely to profit from such effects.
- Small companies could be affected by administrative problems applying for a label, and a lack of capacity to follow the market promoted by the label. Because this group is very diverse it is not easy to verify this hypothesis. However, there are concerns about the additional bureaucracy and costs.
- Introducing energy efficiency labels and other measures would promote trends towards concentration of the market. Promoting efficient systems could support existing trends towards market concentration. On the other hand, actions promoting efficiency may not necessarily be harmful to smaller companies. For example, solar systems, heat pumps, biomass, and other niche technologies would bring market opportunities for innovative smaller companies.

The survey and interviews, as well as the existing market analysis gave similar results. Companies belonging to problem groups mentioned above seem to be not very widespread in industry. Also no evidence was found that the possible effects will be really severe. This conclusion is strengthened by the expectation of industry that a label will have positive, but quite limited effects.

7.   Definition of possible labels

The discussions and work undertaken in this project made it clear that labelling heating systems involves many complex issues, particularly compared with labelling appliances such as refrigerators. These issues include how to compare different fuels (that is, whether on the basis of CO_2 emissions, costs, primary energy, or some other parameter), households heated to different standards (particularly the differences between room heaters and central heating), block/district heating and apportioning energy use for CHP, dealing with regional climatic differences, and how to treat fuels from renewable sources, such as wood.

A label comparing different types of heating systems, perhaps including the effect of the building, may be desirable in the long term, to provide the consumer with information, and thereby promote improved energy efficiency. However, many issues would need to be resolved to achieve this. It would be advisable, as a first step, to develop a label for new gas and oil boilers, based on their efficiency. This is a natural development of the European Directive 92/42/EEC which defines a minimum efficiency.

Alternatively, some industry contacts expressed a wish for a single label for all energy sources, including electric heating, based on primary energy. This could be achieved by developing a norm that already exists in Germany. It would enable the electricity used by central heating to be included, and would also indicate the potential benefit of changing the energy source of a heating system.

Industry representatives from AFECI, EHI (formerly EBA) and Marcogaz joined one of our partner meetings. This identified a concern that a boiler label on its own was insufficient to ensure that the heating system performed as indicated by the label. To meet this concern, a boiler label scheme should have an associated information sheet, describing 'best practice' for such aspects as the installation, control system, electrical consumption, maintenance, and use. This would have significant benefits, including allowing a boiler labelling scheme to promote energy efficiency for the whole heating system.

8.   Conclusions

This project was ambitious in its scope and range of tasks. This was appropriate, because of the importance of developing policies to realise the significant existing potential to reduce the energy use, and carbon emissions, of heating systems . This is reflected in relevant Directives currently being considered, the Buildings Directive, the Framework Directive on Minimum Efficiency Standards, and the revised Framework Directive on Labels In the tasks, available data has been thoroughly assessed against the background of standards, regulations, market barriers and opportunities in EU countries.

A model has been developed describing the number of heating systems of each type, in each EU country, in 1995 and 2005. This data set is of a high quality and consistency, and the linear model has given a good first approximation of energy trends. It was used to generate 'business as usual' and 'efficiency' scenarios of energy to 2020. Data sources have now been identified which would enable development of a dynamic model. This would enable analysis of important non-linear effects, such as uneven stock build up, temporary legislative measures, and small sectors such as renewables, and electric floor heating. The model could also be improved by including hot water energy provided by central heating, incorporating improved methods for estimating seasonal efficiency, and developing the methods for dealing with electricity. *It is therefore recommended that the Commission develop the current model into a dynamic stock model, which would provide improved accuracy and robustness in assessing energy and carbon emission trends for energy policy support.*

The many complex issues involved in labelling heating systems have been considered. A natural development of Directive 92/42/EEC, which defines a minimum efficiency, would be a label for new boilers based on their efficiency. Alternatively, a single integrated label for all energy sources would indicate the benefits of changing energy source, and enable central heating electricity use to be included. In either case, a boiler label on its own may be insufficient to ensure efficient operation of the system. Any scheme should therefore include an information sheet describing best practice for such aspects as installation, maintenance, use, and control systems. *It is suggested that a further project should develop details of such a labelling scheme, and the specific information to be included as part of such a scheme. Consideration should also be given to revision of the current minimum efficiency of heat generators.*