

SAVE II ACTION  
Contract no. XVII/4.1031/ Z/99/283  
Labelling and other measures for heating systems in dwellings

## **Appendix 6**

### **Market barriers and opportunities**

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# BARRIERS & OPPORTUNITIES

## 1 INTRODUCTION

This task concerns the barriers and opportunities which can influence the development of Heating Systems in Dwellings. This is an introduction to the measures proposed in the following task of this study about Heating Systems in Dwellings.

All European countries were and are again recently influenced by energy crises. The different crises have had the effects of pushing respective governments to define an energy strategy which is different according to the country.

Their respective policy has been based on 3 main objectives:

- to reduce national energy dependence while developing national resources, (coal, gas or nuclear program, according to the country),
- to diversify energy supplies by type and geographic origin and increase renewable energy contributions,
- to improve final consumption through better energy efficiency (district heating, energy saving in buildings).

To achieve these aims several tools have been put in place according to the national strategy:

- legislation, regulations and standards on products (boilers, controls systems,...),
- taxes on energy,
- state funding for research and development of energy technologies, energy auditing,
- subsidies for efficient technique, marketing and implementation of new energy-saving technologies, renovation of building,
- energy conservation agreements,
- information for the consumer, but also engineers, architects, installers of heating systems.

Today, the reduction of energy consumption in dwelling is still topical and interest in these measures is being enforced by the rising awareness of the risk of climate changes which represents new economic and political issues.

Heating system energy consumption in the 9 countries in this study (Denmark, Finland, France, Germany, Ireland, Italy, The Netherlands, Sweden, United Kingdom) accounts for 90% of total energy consumption by heating systems in the 15 EU countries (in 2000, annual energy consumption: 1.64 PWh).

The energy consumption for space heating in dwellings is one of the largest components of consumption. And even if this consumption is decreasing<sup>1</sup>, its represents 69% of total

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<sup>1</sup> In 1960, in European Countries, 97 millions of dwellings used 1,78 PWh; in 2000, 152 millions of dwellings use 1, 64 PWh.

European Union household consumption and corresponds to a share of 15 % to 22 % of the total final energy consumption.

To appreciate these perspectives of potential reduction in heating systems for dwelling, this report aims to present the different barriers and opportunities which are able to influence the development of energy efficiency of heating systems in dwellings through the attitude of market actors and to assess the possibility of constructing a labelling scheme.

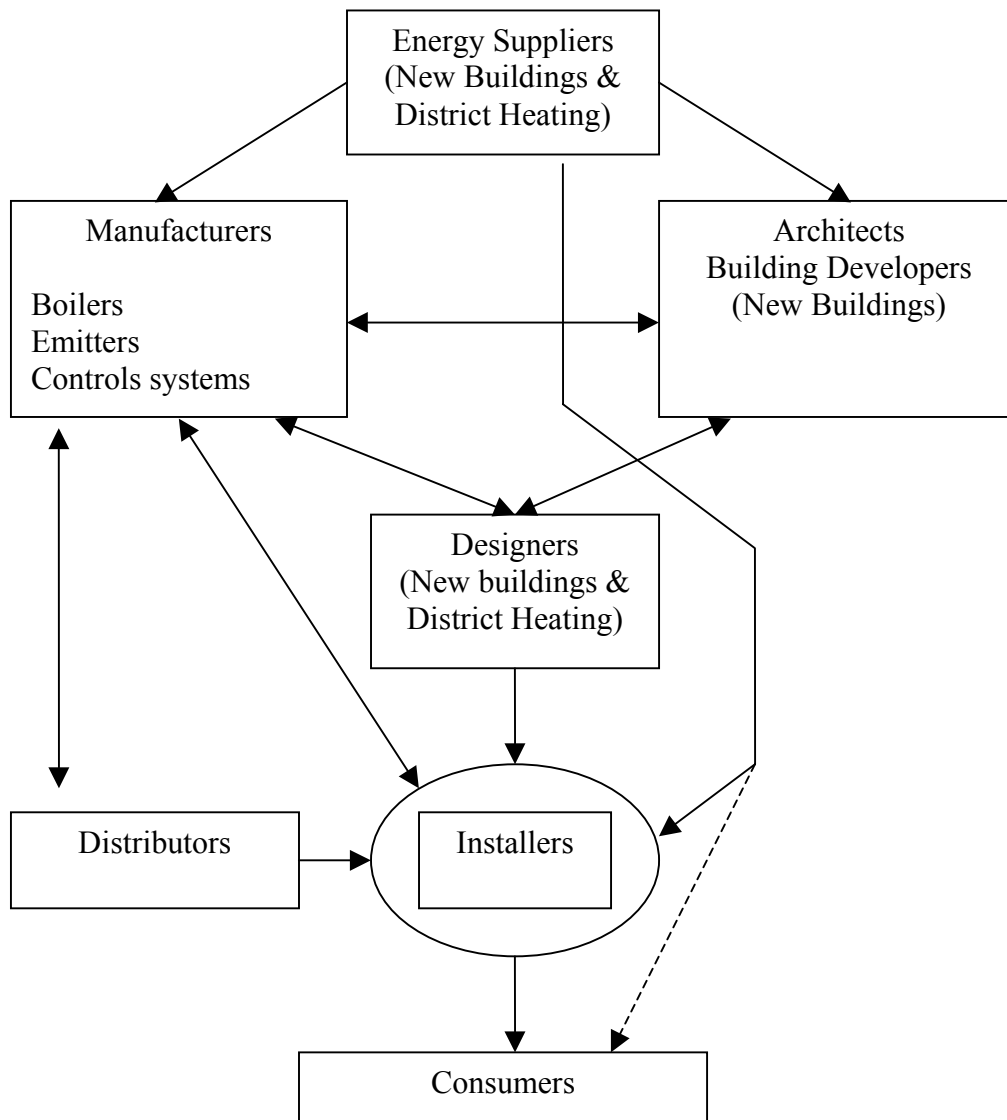
The first part gives a view of the roles and attitudes of market actors through some standards and financial tools, developed in each country of European Union.

The second part of the report presents the mains barriers and interests of labelling schemes of heating systems in the European Union.

## 2 MARKET ACTORS

The market of heating systems is made up of numerous professionals who influence the consumer to varying degrees and create a complex pattern of relationship. In this pattern, installers are the main strategic point of the market, particularly in the replacement and renovation market.

The relationship between the market actors can be summarized as follow:



The present scheme shows the influence of the market actors who are, in order of importance:

- Installers and architects / building developers, who are the main deciders in existing or new buildings respectively,
- consumers, who are the final users,
- the manufacturers and the distributors, who make and sell the products,
- the energy suppliers.

Their respective roles and attitudes are expressed in the following chapters.

## **2.1 Manufacturers**

### **2.1.1 The role of Manufacturers**

The role of the manufacturer is:

- to produce and to sell boilers and others components of heating systems,
- to improve the product according to the regulations and the market,
- to obtain the loyalty of installers (for example by the way of training) who are the main representative of their brand.

The relationship between manufacturers and the others actors of heating systems market must be considered according to the age of buildings.

In the new building market, manufacturers trade directly with the architect or the building developer with regard to the range of heating systems which could be installed. The share of heating systems in the new building market represents about 20% by year. In this case, manufacturers specify, with architects, and can be the designers of the heating systems.

In the existing building market, installers and distributors are the main actors with manufacturers. Installers are the main deciders close to the consumers when it is necessary to replace a boiler or renew the existing heating system. So, for manufacturers, the loyalty of installers is important. The installer are their best representatives close to the consumers. Also manufacturers organize programmes of training courses for them with the aim of proving the ease of installation and maintenance of their products.

But, if manufacturers take some initiatives to sell their products, it is a fact that the programme of training course with regards to energy efficiency could be better. Indeed, there are numerous installers who seem to ignore what level of efficiency of boilers they install.

These programmes of training courses for installers could be a good opportunity to give:

- a good level of training about energy efficiency,
- more importance to the quality of the whole heating system.

This role of the manufacturers is not in contradiction with their aims of selling.

### **2.1.2 Attitudes toward energy efficiency**

The attitude of manufacturers towards energy efficiency can be described as follows:

- the effect of regulations and standards,
- innovation and research,
- communication of information to the installer.

Two main types of industry can be distinguished according to the power of the generator :

- power < 400 kW,
- power > 400 kW.

Today, manufacturers are able to make efficient products, and the majority of new boilers sold, and actually installed, have an efficiency higher than required by European Union Directive.

## 2.1.2.1 Product Standards

### 2.1.2.1.1 The boiler

#### 2.1.2.1.1.1 Domestic boiler

There is only one norm concerning energy efficiency of boilers. This standard is defined by the Directive 92/42/CEE, which is applied in all European countries.

Manufacturers respect the European Directive boiler, but only a few of them have accepted the stars label systems. This labelling is voluntary. But the different levels of star on the label seem to be poorly adapted to permit an indisputable placing after laboratory tests.

The regulation applied in every European countries, for the **boiler** is the EU **Directive 92/42/EEC** which states: "This Directive, which comes under the SAVE programme concerning the promotion of energy efficiency in the Community, determines the efficiency requirements applicable to new hot-water boilers fired by liquid or gaseous fuels with a rated output of no less than 4 kW and no more than 400 kW, hereinafter called 'boilers'"<sup>2</sup>.

This regulation, which enforced a minimum efficiency, has not imposed high efficiency boilers on the market. The impact of the regulation has been to confirm what was already available on the market without giving a real impulse to the best products.

Also, some countries have put in place regulation to replace boilers before failure or install efficient products. This is the case of **Germany**, where in general, new installed boilers have to be low-temperature boilers or condensing boilers. This is required by energy saving laws (Heizungsanlagenverordnung).

Another Decree concerns the replacement before failure of existing boilers according to their heat losses. This Decree on small boiler (Kleinf Feuerungsanlagenverordnung) defines deadlines for replacement of existing boilers<sup>3</sup>:

Nominal power of boilers	100 kW	> 100 kW
Exceeding of permitted losses by	Deadline for replacement	
3 % or more	1/11/2001	1/11/1999
2 %	1/11/2002	1/11/2002
1 %	1/11/2004	1/11/2004

**In other countries, there is no obligation to replace the boiler before failure.**

#### 2.1.2.1.1.2 Boiler power included between 400kW to 50MW

In **France**, the Decree 98-817 of 11 September 1998 specifies minimal energy efficiency (between 70% to 89%) and equipment for boiler with power included between 400kW to 50MW.

<sup>2</sup> COUNCIL DIRECTIVE 92/42/EEC of 21 May 1992 on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels (Article 1).

<sup>3</sup> Institut für Energiewirtschaft und Rationelle Energieanwendung – IER – Germany – Policy Instruments in Germany – 1998.



### 2.1.2.2 Research & Development

Exception for gas turbines or motors for large power systems, there is no specific research on the energy efficiency of heating systems and specifically on the individual boilers. Theories are known and manufacturers develop their products according to financial possibilities and, the most influencing factor, according to their knowledge of the market. So, manufacturers adapt their products to the distribution strategy and to the demand of the consumer.

Indeed, new products meet some problems when trying to win a share of the market because of the price of the new technology (for example, the condensing boiler), particularly in some countries where the competition is great. So, the price of production for new and very efficient products is one of the difficulties that meets the manufacturers when developing their brands.

However the new building market is more receptive to including this new technology (and sometimes existing dwellings in the case of substantial refurbishment (for example: when the kitchen is renewed)).

Moreover, for all concerned technologies, the direction of industrial development is:

- For a reduction of the size of heat generator & emitter,
- For a better integration in the building, with the total disappearance of heating emitters (wall, floor and ceiling heating),
- For more aesthetic products (particularly true for emitters).

For some technologies and components of individual heating systems, the direction of development can be summarized as follow:

#### **Oil / Gas boilers :**

- Reduce the auxiliaries consumption (for pump and fan),
- Reduce the boiler volume (this concerns the boiler interchange),

Also, for other technologies, such as thermal solar, the industrialisation seems to be the major difficulty in reaching a good price.

As regards wood automatic boilers, which reach an energy efficiency of 90%, the main problem is resolving the balance between humidity of the wood and the temperature of the smoke.

Gas-heat pump are developing.

Other technologies, such as fuel cells, are very promising as regards producing heat and electricity, in the case of cogeneration (which is possible under certain conditions) with an energy efficiency of 80% (40/40 – heat/electricity). This technology also offers the possibility of satisfying a wide range of power (from 5kW to 1MW). Some demonstration projects are testing small systems of 5kW power. Some big European Producer (in Germany) or Energy Supplier (in France) are developing fuel-cell heating.

## 2.2 Distributors

The structure of distribution of individual boilers in France is divided in 3 ways as follow :

Manufacturers of heating system components <sup>4</sup>		
Distributors	Installers	Hypermarket
Installers	Users	Users buy the boiler
Users		
78 %	18 %	4 %

The role of distributors can be important (this represents 78% of the market), even if their influence can seem marginal with regard to energy efficiency.

The Distributor selects the manufacturer taking into account the brand quality, the price, the delay and the services.

**Distributors can influence installers when they carry out marketing actions and commercial offers for efficient products. These types of activities can be favourable to condensing boilers or other efficient components of heating systems.**

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<sup>4</sup> MSI Study : « Marché du chauffage central et chauffage électrique dans le secteur résidentiel. » - Nov. 1999.

## 2.3 Professional Installers

In every country of the EU, installers are qualified or their experience is recognised after 3 years of work, but a diploma is not always required to design, to install or to maintain the heating systems in existing building, especially towards to the small power. Also, even though there is regulation to maintain large power plants (maintenance which is not always applied for all large systems), there is no specific regulation to impose qualified persons to do the work<sup>5</sup>.

The level of qualification & distribution of installers/designers on the market can be expressed as follows<sup>6</sup>:

Installers	75%	low level
Technicians to install large power systems	15%	technician
Engineers to design	10%	Engineer

However for security and safety reasons and concerning a new installation of complete gas-fired heating systems (including boiler, duct, pipes) or electric installation, qualified and/or competent persons are required.

Most of people who work on gas-fired equipment must have been suitably trained and must have achieved a Certificate in gas servicing. Their work is controlled and recent evaluations show that installations are better realized than in the past.

Generally<sup>7</sup>, there is always no similar restriction on persons maintaining oil-fired or solid fuel fired heaters and boilers<sup>8</sup>. Also in some country, the electric sector, seems, to present a lot of realisations of bad quality by the lack of certificated servicing and control.

Concerning solar and wood technologies, several countries have made a large effort to ensure a good quality of training and qualification of installers. This is of course very important for all new technologies which are getting place in the energy market. But note that, in some countries, bad or insufficient maintenance and lack of training of the installer has contributed to delaying the development of heat pumps or condensing boilers.

### 2.3.1 The role of the installer

So, installers are mainly professional plumbers: they have not a high level of qualification and a lot of them seem to lack some basic knowledge about energy efficiency. Also they are the main person for the specifications of heating systems in existing building. However, in the new building sector, installer are, generally, simple executer who carries out what is planned by the housing developer.

His relationship with the manufacturer is very important. To obtain the loyalty of the installers, manufacturers provide advice, assistance and comprehensive after sales service. They also have rolling programmes of training courses to familiarise installers to their

<sup>5</sup> Except in Germany

<sup>6</sup> For France : Information from personal communication with Federations of Professionals.

<sup>7</sup> What does not mean that it is right for all European Countries.

<sup>8</sup> In Germany, people dealing with gas and oil have to have the same qualification.

products. **But, these programmes usually forget to inform installers about the importance of efficiency. In fact, the ease of installation and the reliability of the boiler are still more important for the installer than other types of information.**

Usually, the installer has a great influence on the consumer. Sometimes he decides what type of boiler is installed.

### **2.3.2 Attitudes towards energy efficiency**

The attitude of the installer towards energy efficiency can be summarized by three main points:

- the low level of qualification and the lack of interest by some of them, as expressed above,
- the lack of regulation on procedures of design, installation and maintenance applied for individual heating systems in the market of existing buildings, does not impose more liability to the installer when he is installing another boiler or maintaining one.
- the lack of interest for efficient products, for example condensing boilers.

During the 1980's, condensing boiler were subsidised by some governments. At this time, manufacturers developed their products without enough background work before selling them. Also, installers were not very attentive to the maintenance of this new technology, and this contributed to a bad reputation for this type of products. So, in some European countries now installers don't want to install condensing boilers even if it were possible. Also, the price of these boilers is too expensive, which makes it unfavourable to develop the market for efficient boilers. However, incentives for condensing boilers seems to be one possible way, which is already the case in Denmark and The Netherlands. And regulations in Germany give a large opportunity for these products. But, in other European countries, installers are still waiting to be persuaded of the reliability of this technology.

Also, when installers are interested in the efficiency, they think that the improvement of a heating system is in better control, not in other parts of the system, like insulation of pipes for example.

Also, in some countries, for the middle range of boiler (400kW to 2MW), which are installed in apartment blocks and managed by the owners of buildings, the installers and maintenance staff seem to be less concerned if their work is not correct, so the level of these systems is usually lower than it could be possible.

The larger collective heating systems are better maintained, and their energy efficiency is constant during the time.

**The main objective of the installer is to install products which are easy to install and to maintain. Energy efficiency is not their first preoccupation.**

Procedure standards, according to different case of intervention of the installer, are described hereafter.

### 2.3.2.1 Procedure Standards

Regarding the design and/or the installation procedure for heating systems in **existing buildings**, the main rules concern **security and safety**, not especially to the efficiency. For security and safety reasons, an installation of a new system (for gas-fired and new electric installation<sup>9</sup>) must be checked or installed by competent contractor. However, a boiler replacement does not always require a specific procedure or a qualified person.

Size of domestic boiler is generally estimated by ratio by an installer, and calculated by experts in large buildings.

#### 2.3.2.1.1 Procedure for design

Except in **Italy** and **Germany**, there is no rule, no procedure required to design the heating systems *in existing buildings*. In new buildings, procedures are required in every European countries by thermal regulations or building codes, which are presented in chapter 2.4 “Architects and Building Developers”.

In **Germany**, for the replacement of heating system has to be done or at least certified by a qualified company, but there are hardly any controls. Depending on the building order a certificate of accordance to public rules by a qualified company or an independent expert is obligatory for new or changed heating systems.

If a standard boiler is installed a calculation of the energy requirement of the building is obligatory.

In **Italy**, the Presidential Decree 412/1993 imposes that the design of new buildings or substantial restructuring of existing ones must be carried out aiming at reducing heat and electricity consumption. A technical report confirming the respect of rules limiting energy consumption must be submitted and can concern:

- new heating systems or restructuring of existing ones,
- replacement of heat generators if power exceed 35 kW.

**In existing building market, the lack of procedure standards to specify the size of the boiler is a disadvantage for the consumer. This is also true for a new installation or replacement of boiler.**

#### 2.3.2.1.2 Procedure for installation

A procedure for installation is required for new buildings. For existing buildings, except in **Italy**, and in **Germany**, there is no specific regulation for the installation procedure. In the most of cases, there is only a guideline giving the recommendation to follow which may or may not be followed by the installer.

Also, some countries have put in place regulation to replace boilers before failure or install efficient products. This is the case in **Germany**, where in general, new installed boilers have to be low-temperature boilers or condensing boilers (standards boilers are allowed except for

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<sup>9</sup> For France

very limited exceptions). This is required by energy saving laws (Heizungsanlagenverordnung).

Another Decree concerns the replacement before failure of existing boilers according to their heat losses. This Decree on small boiler (Kleinf Feuerungsanlagenverordnung) defines deadlines for the replacement of existing boilers<sup>10</sup>:

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**In other countries, there is no obligation to replace the boiler before failure.**

Also, in the case of replacement or renewal of heating system, the installer is the person who specifies the range of boiler which must correspond to the needs of the consumer. In the numerous cases, installed boilers are oversized by some kW. This over-sizing does not correspond to a way to secure the installation, but benefits financially to the installer.

**A new installation or replacement of boiler could be an opportunity to check the quality of heating systems towards the energy efficiency, but this approach is a voluntary engagement of the installer.**

### 2.3.2.1.3 Procedure for maintenance

Procedure for maintenance are required depending of the size of the boiler.

#### 2.3.2.1.3.1 Domestic boilers

For domestic boilers, there is no regulation, compelling the regular testing of heating systems efficiency in existing building, except in **Germany** and **Italy**.

But for reasons of safety, regulations impose annual checks of the combustion of the boiler, and chimney sweeping of the duct by competent contractors in the major of the European countries. In other cases, there are guidelines (safety guidelines) that encourage people to do yearly maintenance /inspection<sup>11</sup>.

The application by the consumer of this periodic maintenance, required by this regulation, is not controlled.

In **Germany**, Energy saving rules say that heating systems bigger than 50 kW have to be serviced twice a year. The service has to be made by qualified personnel.

The rule called “Kleinf Feuerungsanlagenverordnung” defines that existing boilers have to be retrofitted or exchanged up to 11/1/2004 (see chapter above).

The planned “Energieeinsparverordnung” defines that boilers installed before October 1978 have to be exchanged up to the end of 2005. Except for recent retrofitted boilers that to be exchanged until the end of 2008.

<sup>10</sup> Institut für Energiewirtschaft und Rationelle Energieanwendung – IER – Germany – Policy Instruments in Germany – 1998.

<sup>11</sup> The manufacturer’s installation guide and the user’s manual, the manufacturers mention the need for yearly inspection. If the product is not serviced adequately during a period of years, the manufacturer will no longer carry product liability.

In **Italy**, the Presidential decree 412/1993 defines three different categories (one concerns installation of large power) of heat generators which undergo different regulations.

The responsible person (the owner or the administrator of a condominium or a professional delegate) must assure a regular maintenance of the whole system which includes :

- For heat generators whose power is between 35 and 350 kW
  - same as above but only once a year.
- For heat generators whose power is under 35 kW
  - cleaning of the heat generator,
  - generic check of the generator.

All these operations are strictly defined through UNI norms (UNI is the national unification institute). If combustion check fails the minimum requirements, then the responsible person will have to carry out all required operations.

#### **2.3.2.1.4** Very Large Power : Periodic check of energy systems

Some countries, Germany included, have regulated the maintenance of installation of large power.

In **France**, the Decree 98-833 of 16 September 1998 concerns energy installations where the sum of nominal power is equal or up to 1MW. For these, a periodic check (including functioning of control systems, distribution systems and combustion of the boilers) has to be effective all 3 years. If the check procedure isn't positive, the owner or the operator of the installation has to set to the norms in the 3 next months.

In **Italy**, the installation of power up to 350 kW are also regulated by the Presidential decree 412/1993. The responsible person (the owner or the administrator of a condominium or a professional delegate) must assure a regular maintenance (cleaning and check) of the whole heating system according to the power of the installation.

In **The Netherlands**, requirements for regulatory heat generator service concern boiler of power up to 130 kW. These boilers need to be inspected/serviced every year; there is mandatory environmental legislation on this issue.

## 2.4 Architects and Building Developers

Architects and Building Developers influence the market of new buildings. Their objective is to build dwellings to a better price. So, the price of equipment is an important aspect of their choice design.

Also, building developers consider heating system as a secondary equipment of building. They think too that the buyer is not interested in buying an efficient heating systems which represents an added cost on the house which is not justified<sup>12</sup>.

However, in the case of a important building programme, the building developer negotiate numerous boilers to a good price and this could be an opportunity to install efficient products.

According to the country, the level of performance of the boiler, installed in new building, is required by Thermal Regulation or Building Code. Also, Heating Specification are defined by the manufacturer.

Up to the present, some countries have not imposed at chimney in new housing. So, electric heating has obtained a large part of heating market because of the absence of other heating possibilities. This is changing due to new thermal regulation in new buildings<sup>13</sup>.

### 2.4.1 Thermal Regulations & Building Codes

Since the first energy crisis, European countries have developed thermal regulations which are one of the best ways to improve the energy efficiency in the building sector. But, thermal regulation, in all countries of European Union, concerns exclusively new buildings or new extensions to old ones. So, old buildings are not taken into account<sup>14</sup> and represents a important potential for energy saving.

These rules of design concern thermal insulation of building and energy systems, such as heating systems, hot water generation, control systems, pipes and ducts, heat emitters...

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<sup>12</sup> This could be right for young people, who generally don't care about heating systems, but not for all buyers.

<sup>13</sup> The new Thermal Regulation (2000) in France required the possibility of changing of heating systems using another energy. This changing must be realised without important intervention on the building structures. And concerns individual and collective buildings.

<sup>14</sup> Except in Italy, where Presidential Decree 412/1993 concerns new or substantial restructuring of existing buildings, there is no application for existing buildings. And in **The Netherlands** where during the Third Memorandum on Energy Conservation (EZ, 1998), the government proposed to apply energy performance standards to existing dwellings as well. The energy performance of the 3 million dwellings built before 1985 should be made equivalent to the insulation standards which were introduced afterwards. The costs per dwelling is estimated to be 2,246 €. The government suggests that until the year 2004 a voluntary approach could be taken (including temporary financial and/or fiscal support, pilot and demonstration projects).

Afterwards a decision will be taken how to make the energy performance standards for existing houses obligatory.



Several countries, which up to now have pursued the unit approach or the approach using a global transmission value, are discussing the introduction of more integrated approaches with reference to the thermal insulation regulations in other countries (this is the case in Finland). Otherwise other countries are preparing to tighten up their thermal insulation regulations with reference to obligations of primary use or CO<sub>2</sub> reduction (e.g. Germany, Finland)<sup>15</sup>. There are two family approaches: The fully integrative approach<sup>16</sup> (France, Italy, Netherlands, UK). And the unit approach too (DK, Finland, Germany, Ireland).

Concerning Heating Systems in new buildings, thermal regulations define rules of design and the minimum product standard to respect, which are sometimes higher than the European Directive requirement for boiler<sup>17</sup>.

#### **2.4.1.1 Boiler efficiency**

The efficiency of hot water boilers, used both for space heating and tap water, is determined by the regulations. This regulation is the application of the EC directive 92/42/EEC to every European countries. The main provision is that new boilers using liquid or gaseous fuels shall conform to the efficiency requirements. However this does not apply to solid-fuel heating which is still important<sup>18</sup>.

Also for so-called back boilers/gas fire combinations and boilers installed in the living space lower efficiency requirements are set. These systems transmit the heat in part directly to the ambient air in the living space.

Additionally all countries make or will make available user-friendly software to perform the calculations.

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<sup>15</sup> MURE database : A Comparison of Thermal Insulation Regulations in the European Union

<sup>16</sup> Germany: Planned for 2002.

<sup>17</sup> The French Thermal Regulation require a high level of boiler than it is defined in the European Directive.

<sup>18</sup> In Ireland.

Comparison of Thermal Insulation Regulations : Overview of regulations to reduce the heating. This comparison is issued of the MURE Database Case Study.

Country	Denmark	Finland	France	Germany	Ireland	Italy	Netherlands	Sweden	UK
Introduction of regulation									1965
	1972		1974						1974/76
	1977	1976	1982	1977		1977		1980	1985
	1982	1978	1989	1982		1986	1991	1985	1991
	1995	1985	2000	1994	1991	1989	1995	1994	1994
Degree day figures (basis 20°C average)	3191	5978	2850	3845	2979	2234	3550	4355	3210
Number of climatic zones	1	1	3	1	1	6	1	1	1
Difference fuels/electricity	No	No	Yes	No	No	No	No	No	No
Classification									
<i>Unit approach building shell</i>	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
<i>Avg. Transmission building shell</i>	No	No	No	No	Yes	No	Yes(91)	Yes	Yes
<i>Heating demand of building</i>	Yes	Disc. <sup>1</sup>	No	Yes	No	No	No	No	No
<i>Fully integrative approach</i>	No	Disc.	Yes	Disc. <sup>1</sup>	No	Yes	Yes(95)	No	Yes
Reduction of energy consumption compared with previous stage	25%	10%	25%	30%	25%				25%
Applicability									
<i>New buildings</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>New extensions to old buildings</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Old buildings</i>	No	No	No	No	No	No	No	No	No
Revision planned for		1998+	2005						
	2005	2003	2010	2002	1997	-	1998+2001	1998	2001

“Disc” means that the corresponding approach is under discussion

All construction actors are concerned for their specific involvement :

- manufacturers as the regulations lead to new markets for efficient technologies whose combinations are necessary to obtain the global result expected,
- consultants who will have to elaborate projects of construction integrating new rules,
- construction companies and installers which have to realize the building.

Many products are directly concerned by thermal / building coded: insulation for walls, high efficiency and low emissive glazing, fossil fuels and electric heat generators, heat distribution networks, command systems, air renovation systems...

According to the country, the controls are executed on the design project before construction of the building and in this case not realized « in situ » to assess reality in respect of the rules, calculations and results.

A rough evaluation by survey of construction projects has been undertaken by ADEME in France. It shows that in half of the cases studied, regulation is not respected but that the level of obtained efficiency is not so far from the expected scope.

### 2.4.1.2 Impact of Thermal Regulation on the boiler market

Generally, Thermal Regulations and Building Codes improve the introduction of efficient boilers and heating system components, but the prohibitive prices of efficient products prevent these regulations having a real impact on the market development of very efficient products.

However, the impact of Thermal Regulations and Building Codes on the market for existing heating systems (for example in the case of replacement boilers) was not without effect, but is still very weak regarding the development of the condensing boilers market.

**This may be due to the European Directive on gas and oil boilers, which has confirmed the reality of the market boilers rather than created a tension aiming to improve energy efficiency by the promotion of efficient products.**

### 2.4.2 Other regulations

Other regulations concern metering for collective heating and temperature for space heating, district heating and reversibility of energy supply. These regulations are influencing the new market and collective building.

#### 2.4.2.1 Metering for apartment block & district heating.

In **Germany**, and from 1999 in **Denmark**, all energy and water consumption must be based on individual measurements<sup>19</sup>. The idea is to increase the incentive for energy savings<sup>20</sup>. In Germany, the Decree on Heating Costs<sup>21</sup> regulates the accounting of cost for space heating and hot tap water. It obliges owners of houses to measure the heat and hot tap water demand and to settle accounts corresponding to the actual energy consumption including costs for the heating system.

#### 2.4.2.2 Restriction of space heating temperature and seasonal obligations

##### 2.4.2.2.1 Index of standard temperature in the housing

In some countries, there is obligation to control mean temperature in dwellings: must not exceed 20° degrees (plus 2° tolerance) in **Italy**. In **France** all new housings (built after June 2001) that have to be heated to maintain 18° temperature (centre of the room), with energy consumption limited. All systems have to be designed with automatic control systems and permit the user to reduce the internal temperature under 18°C.

##### 2.4.2.2.2 Seasonal obligations

About collective heating, there are obligations that the heating has to work between October and April or May, according to the country and their regions. Also, in **Germany**, outside heating period, it has to work when outside temperatures are lower than 15 °C.

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<sup>19</sup> Byggeog Boligstyrelsen 1996

<sup>20</sup> Institute of Local Government Studies (AFK) – Denmark – Existing Policy Instruments in Denmark – 1998.

<sup>21</sup> Verordnung über die verbrauchsabhängige Abrechnung der Heiz- und Warmwasserkosten (Verordnung über Heizkostenabrechnung - HeizkostenV), vom 20/01/1989 BGBl. 1989 I S. 115

### 2.4.2.3 Reversibility of energy supply

In **France**, like it is specified in article 22-4, the Law « Loi sur l'air et de l'utilisation rationnelle de l'énergie » to impose building of housing with the possibility of changing the supply of energy, during the building life.

Decree 2000-1152 of 29 November 2000, Article 4: specify that it must be possible, without excessive surcharge on the housing to change the energy systems. And for collective dwellings, it has to be a reserved possibility to connect to the urban district or to install collective heating systems with gas, liquid or solid fuel.

### 2.4.2.4 District heating classification

To stimulate the District heating market, some countries have framed with regulation.

In **Denmark**, new houses in areas with district heating or natural gas is not allowed to install electric heating<sup>22</sup>.

In **France**<sup>23</sup> the Decree 99-360 of 5 May of 1999 concerns condition about classification as district heating which can be classed as such<sup>24</sup>:

- good financial balance,
- 50% and more thermal energy has to be produced by renewable energies, heat recovery or cogeneration installations.

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<sup>22</sup> Energistyrelsen – 1998.

<sup>23</sup> See also precedent § “Reversibility of energy supply”.

<sup>24</sup> Note : classification imposes to apply a legal procedure to agree connection to the district heating. This decision is the fact of local municipalities.

## 2.5 Energy suppliers

Energy suppliers expend a lot of efforts to win energy market shares. Their influence is important in new building market, where electricity and gas heating systems win each year, more and more on oil heating systems. Situation which is the fact of increase of petrol price. But, their interventions could be not very exact without consideration of the context of deregulation of electricity and gas markets which are out of the framework of this study.

Also, according to the importance of building programme, energy stake are not the same for large power for collective heating systems and individual heating systems. So, the development of district heating and CHP sector is particularly sensitive at this aspect, even if the district heating market is still marginal.

**In the field of existing buildings, the role of energy suppliers can be summarized by their marketing campaign. But, in France, for example, the role of energy suppliers is more direct towards consumers.**

### 2.5.1 Subsidies & Services by Energy Suppliers

In **France**, since 1997, EDF has launched « VIVRELEC » project which aims to develop customer loyalty for electric heating as its market share has been going down for some years. 900 to 2 100 €/dwelling is allocated to builders or households who chose electric heating with high requirements for insulation in new construction (10 to 20 % reduction compared to 1989 regulation). This type of programme was also applied to existing buildings.

In next June 2001, EDF will propose a new programme of subsidies with three types of subsidies and one loan with low rate.

The level of the two first subsidies depend of the type of dwelling:

- quality measure (75 € to 300 €),
- energetic performance (for individual house: 2 to 4 €; for apartment : 1,5 to 3 €),
- marketing actions for owners and foremen.

And a financial offer of 65 to 100€/m<sup>2</sup> with low rate (3% during 7 years).

The subsidies programme is associated to the label PROMOTELEC.

EDF has also developed media tools by internet for the installers to help them in the promotion of VIVRELEC campaign.

#### Services

At the moment, the suppliers are preparing for market liberalisation by putting in place several services for the attention of the consumers and installers (EDF has design a web site to the attention of installers giving information about subsidies, the way to manage a project... ).

GdF is thinking too about an energy efficiency procedure by the way of a diagnostic.

EdF and GdF have also their own training services for representative companies, by the way of Qualifelec and Qualigaz certification.

In **The Netherlands**, there are subsidies for heat pumps and solar boilers which are still available through the distribution companies. In the past, subsidies for insulation of houses

and for condensing boilers were supported by the revenues from the MAP levy, a tax introduced by the government and continued by the distribution companies.

## 2.6 Consumers

### 2.6.1 Householder Attitudes

Householder attitudes are different between countries because of environmental culture, education and are not the same which affects the thermal comfort<sup>25</sup>. The impacts of energy crises, with increasing energy price, have caused a decrease of energy consumption (2/3 of decreasing consumption are link to the changing of attitude).

Some general indicators may be common for European countries<sup>26</sup>:

- The type of dwelling: in a house, the consumer takes care about his energy consumption. This is also true for a householder who lives in an apartment (with collective heating systems) with metering. Generally, the lack of metering is synonymous with greater consumption.
- The type of energy: the consumer may also pay attention to the consumption (specifically when the energy is expensive) and generally the consumer accepts to reducing the temperature of 6 to 7°C.
- The age of the householder is important too:
  - young people have an attitude which does not consider efficiency,
  - 35 to 50 years old: the householder has a good attitude towards efficient energy,
  - 50 to 60 years old: these people invest in assessment of insulation, efficient energy product.
- The householder is sensitive to the facility of using of heating systems (on/off systems),
- People with low incomes take care about heating consumption, but they can't invest in efficient products.
- Generally, two or three years after buying an apartment, the new owner replaces the boiler for a new one.
- Old people (which use today, an coal/wood heating system) want to replace their "manual" heating system by a gas or oil one.

**Also, 50% of the holders get maintenance<sup>27</sup> for heat generators. Generally, there is regulation about sanitary aspects (cleaning ducts, chimneys,...). This low rate is the fact of the lack of control, or obligation about efficiency energy of boilers.**

The ECI study<sup>28</sup> gives a good view of attitude of consumers of United Kingdom about their heating systems. The results of this study can also represent the general attitude in European

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<sup>25</sup> Thermal comfort is influenced by objective indicators and subjective perspectives:

- physiological perceptions,
- cultural references,
- symbolic dimensions.

<sup>26</sup> France: See CSTB (Centre Scientifique & Technique du Bâtiment) study – 1986.

<sup>27</sup> In France: 50% ; Germany: 60 to 70%

<sup>28</sup> "The UK domestic heating industry – Actors, Networks and Theories" - Study conducted by ECI and GfK marketing in November 1999.

countries, particularly in the northern countries. But, it is important to remember that the northern European countries are more sensitive to environmental questions than the southern ones.

A difference between householder consumer can be done. In the case of individual heating system, the householder behaviour seems to be more influenced by the installer, and there is not enough information about heating systems.

But, this is very different in the case of collective of heating systems, where householders are more attentive . May be this is due to the higher share of investment and a greater liability into the choice of systems.

The following study describes the behaviour of the consumer, who has his own heating system. The main information are summarised here:

- Reasons for new installation of heating systems,
- How does the consumer get the information ?
- Who installs the heating system ?
- Who takes the decision ?
- Interest for Energy Efficiency.

#### 2.6.1.1 Reasons for new installation of heating systems

<b>Reason for installation of new heating systems<sup>29</sup></b>	<b>%</b>
Fault or breakdown	49
Old installation probably going to break down	14
Reorganisation due to other building project	7
(to satisfy) New requirements	7
New kitchen	6
No heating before	6
<b>Efficiency concerns</b>	4
Safety	2
Extension	2
<b>Wasting money concerns</b>	1
Comfort/Level of service concerns	1
Other	3
Total	100

**This shows that the main reason for installation of new heating systems is due to the breakdown or because it is old. Efficiency of the system and consumption are not motivating.**

#### 2.6.1.2 How does the consumer get the information ?

<sup>29</sup> “The UK domestic heating industry – Actors, Networks and Theories” - Study conducted by ECI and GfK marketing in November 1999.

The consumers, when they get time to do it (50% consumer are concerned in Northern Europe), try to have information (in particular prices of heating systems,...) and compare generally two or three services provided.

Sometimes the consumer knows what he wants and he takes time to be informed. But, he usually remains under the influence of the installer who remains the main influence.

### 2.6.1.3 Who installs the heating system ?

<b>Who are the Installers ?<sup>30</sup></b>	<b>%</b>
Professional installer	82
Professional installer who is also a friend or relative	10
Friend or relative	4
Me or my spouse or partner	4

**Mainly, the installer of the boiler or heating system is a professional: a plumber.**

But additional information shows that 60% of consumers do not feel that they could trust an installer to do a good job at a reasonable price. The installation industry suffers from something of an image problem. This can explain the reason that some installers estimate that 80% of their work comes from recommendations.

### 2.6.1.4 Who takes the decision ?

Difficult question which does not reflect the reality according into the importance of elements which are considered to take the decision<sup>31</sup>.

	A member of the household with guidance from the installer	<b>The installer alone</b>	A member of the household with no guidance from the installer
%	50	<b>25 to 90 (90 in Southern Europe)</b>	25

The influence of the installer is not the same in all the European countries. In Italy and France, the consumer does not give so much his opinion. And the installer is more influent in the choice of boiler.

<sup>30</sup> “The UK domestic heating industry – Actors, Networks and Theories” - Study conducted by ECI and GfK marketing in November 1999.

<sup>31</sup> “The UK domestic heating industry – Actors, Networks and Theories” - Study conducted by ECI and GfK marketing in November 1999.



To take his decision some elements are taken into consideration by the consumer. These are, knowing that 35% of consumers give a great importance to the manufacturer or model:

<b>Reason for choice of specific brand/make<sup>32</sup></b>	<b>%</b>
Recommendation from installer	55 to 90
Well known make/brand	10
Price	10
Fuel savings/ running costs	5
Appearance	4
Other	6

**Mainly (around 55% for Northern Europe), the installer influences the choice of the consumer, and gives his options of systems or makes and models.** Only, around 25% of consumer decides by themselves what they want “without” to be influenced by the installer.

Other aspects must be described to give a good view of elements which motivate the consumer to take his decision.

Aesthetic aspects and available space must be taken into account here. Often, boilers are put in place in the kitchen. So, the place and aesthetic aspects influence the choice<sup>33</sup>.

#### **2.6.1.5 Interest for Efficiency**

**Mainly the consumer is interested in reducing his energy consumption because he saves money, but he still less interests by the efficiency of the boiler or the heating system.** This point of view can be expressed by :

- a misunderstanding of interest of regarding energy efficiency,
- a misunderstanding of advantage of innovative heating techniques,
- a dissuasive effect of the price of efficient product.

Indeed, the price for efficient products is higher than a standard boiler and the reduction of the bill is not immediately visible for the consumer because the product is bought first and the amount of saving money can be appreciated after some time of using of the new system, according the habit of using of the consumer.

Also, interest in innovative heating techniques is not well perceived: 81% of consumers are not ready to invest in an innovative heating techniques, even if more of 80% of consumers are interested in home energy efficiency or reduction of home energy use. May be is due to the weak engagement of the installer influencing the consumer to choose an efficient product.

The householder attitude brings some reservations that in some countries, according the energy prices, heating needs don't justify a greater investment and the fact that some consumers cannot buy this range of products.

<sup>32</sup> “The UK domestic heating industry – Actors, Networks and Theories” - Study conducted by ECI and GfK marketing in November 1999.

<sup>33</sup> Not in Germany.

This attitude towards environmental subjects is different between northern and southern European countries. This cultural aspect can explain the difference of interest between European countries, but, this difference of attitude is also the result of the climate conditions, so the difference of heating needs.

## **2.6.2 Information to the consumers**

In the past, there were several campaigns of energy efficiency information for the consumer in all European countries<sup>34</sup>. These campaigns generally arose from the fact of energy crises of 1974 and 1986. Their impacts on the consumer were different in each country according to respective environmental culture.

Since these crises, information campaigns are not so strong. But the informative structures are put in place, and they know how to “touch” and influence the consumer. So, the lack of information could be overcome with a political will in the framework of the risk of climate changes management and the recent of energy price rises (petrol, gas).

Regarding the energy efficiency of heating systems, manufacturers and distributors are not really actives because of the lack of direct link with the consumer. The main actors close to the consumer are the installers who provide information during the installation of new boiler or heating system. But this given information is still very slight about energy efficiency. And even regarding the information there is, the price of efficient product can influence the goodwill of the consumer.

Depending on the country, information on energy efficiency (including heating systems) are given by means of a building label. This information is obligatory when the housing is sold<sup>35</sup>.

Another method is the “Best practice” programme in United Kingdom, which is an information dissemination project aiming to provide the latest on energy-efficient practices and technologies in all areas.

Also, British Gas installers promote condensing boilers by offering two quotes, one including a condensing boiler. But, in practice, this information service is ineffective: installers rarely offer the option of a condensing boiler<sup>36</sup>.

Information provided to the consumer, who remains the main decider of replacement or installation of new heating systems (or boiler), needs to be more systematic and objective to have a real impact on his decision.

So, the main problem of information can be summarised by two questions:

- Where can the consumer find it ? an objective one ?
- How to display the information (and make it easy to understand) to influence as many consumers as possible ?

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<sup>34</sup> Several countries also give information about energy efficiency in direction to architects, installers, technicians.

<sup>35</sup> See the chapter 3.1 “Existing label”.

<sup>36</sup> Haug et al. - 1997 & Dept. Of Science, Technology and Society – Utrecht University – The Netherlands – National Survey of Policy Instruments – 1998.

Actually, national institutions, public and private association give information. But this is still general and not always adapted to the needs of the consumer who needs concrete information appropriated to his own case. From the other side, the consumer must do the approach by himself, which is not easy and simple for everybody. So, in the case of heating systems, the installer is first in line to respond to the consumer.

The second difficulty is to give and display objective information. A boiler is not a household appliances like a washing machine or Hoover about which efficiency information is well organized. And the boiler is mainly installed by a professional (Only, 4 to 8 % of consumers buy and install by themselves the boiler or heating systems). Generally, this professional has the confidence of the consumer and his role is important in the choice of boiler.

Also, it is important to recall that the consumption of heating systems is more or less influenced by the quality of the building insulation (which is not the case of other household appliances), the size of the house, the level of comfort attempted and the consumer's habits of use. **To answer to this need, labelling is one of the ways that this study is exploring. An approach for main barriers and interest of labelling scheme is expressed in the chapter below.**

### 2.6.3 Financial and Regulation tools

Different types of tools are used to improve the energy efficiency in the residential sector. Taxes and subsidies are the main ones to be able to influence the consumer:

- Value Added Tax,
- subsidies programmes.

In Germany, there is also a regulation to replace boilers before the end of their natural life.

#### 2.6.3.1 Taxes

There are three types of taxes on final energy consumption by households:

- Energy tax,
- Carbon tax,
- Value Added Tax (VAT).

All of these taxes are applied to the energy consumption. VAT is also applied on products. The Energy and Carbon taxes have different effects in the national economy according to the country and their life in the national taxes system (there is Carbon tax<sup>37</sup> only in some countries: Denmark, Finland, The Netherlands, Sweden; in Sweden there is also Sulphur Tax). So, these taxes exceed the framework of this study, and they are not analysed in this study.

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<sup>37</sup> Carbon tax is still in discussion in the other countries.

### 2.6.3.1.1 The Value Added Tax

The Value Added Tax (VAT) is common European countries. But, it still not applied in Finland. For the rest of Europe, the VAT is between 12.5 % to 25.0%.

The tax is applied on all consumption of fuels or energy sources and also, on the products.

VAT %	
<b>Denmark</b>	<b>25.0</b>
<b>Finland</b>	<b>0</b>
<b>France</b>	<b>19.6</b>
<b>Germany</b>	<b>16.0</b>
<b>Ireland</b>	<b>12.5</b>
<b>Italy</b>	<b>20.0</b>
<b>The Netherlands</b>	<b>17.5</b>
<b>Sweden</b>	<b>25.0</b>
<b>United Kingdom</b>	<b>08.0</b>

In **Denmark**, VAT is not applied to the biomass. In **Italy**, District Heating is taxed at the rate of 10% by VAT. But, the connection to the district cost 10% more. Also, in **France**, VAT for subscription to electricity and gas has a tax (at 5.5%), lower than for District heating subscription which is taxed at 19.6%.

Actually, all countries tax components of heating systems at the current VAT shown above. **So, one of the way to improve energy efficiency, could be to reduce the VAT for efficient products (boilers, controls systems) and clean fuels.**

### 2.6.3.2 Subsidies

All European countries, by the way of their own government, have developed several subsidies programmes<sup>38</sup>. In the following the major programs and activities at state level are described. The major political motivation for most of the activities is the actual CO2-reduction target.

Subsidies aiming at the housing sector mainly focus on reducing the consumption of energy for space heating. Some of the schemes aim at supporting the installation of more energy-efficient heating systems whereas others support investments in energy efficiency.

These different schemes are described below:

- Efficient boilers,
- Switching fuels,
- District heating & Combined Heat Power,
- Alternative fuels.

There is an exception for **Ireland**, where there are no specific government subsidies available to private homeowners intending to improve the energy efficiency of their dwelling. And **The Netherlands** have already closed their programmes of subsidies for condensing boilers and to stimulate the use of energy-efficient heating equipment. Some of these subsidies, decided

<sup>38</sup> There is subsidies programmes driven by the European Commission to the attention of consumer. All programmes are national.

by the government, were continued by the utilities. But now, there are no specific subsidies to promote the use of efficient equipment.

Note that the consumer can also benefit from subsidies from energy suppliers, in **France** for example.

#### 2.6.3.2.1 Efficient products

In some countries as **France**, **Germany**<sup>39</sup>, and **Sweden**<sup>40</sup> there are tax reductions which are granted among other things for investment in energy conservation technologies (this concerns boiler, control systems,...) of existing buildings.

In **France**, there are also two other important schemes :

- **ANAH (National Agency for Housing Retrofit)** : This Agency aims to help households who rent their dwelling to get benefits of all kinds of retrofit works while giving subsidies to the owner of the dwelling. An important part of the subsidies is allocated to energy efficiency retrofits (457 to 915 € for heating boiler with gas or oil).
- **PALLULOS** : « PALLULOS » is a Public fund which aims to help social housing organisms to retrofit their patrimony. An important part of the subsidies is also allocated to energy efficiency retrofits.

In **Germany**, there are also subsidies for low-energy houses<sup>41</sup> : A low energy house is defined to have an average energy demand which is 25 % lower than required by the actual Decree on Space Heating Demand.

There are also low interest loans for investments in efficient heating systems and insulation.

#### 2.6.3.2.2 Switching fuels

Very few European countries promote the switching of fuels by subsidies programmes. These schemes correspond to national problems (reduction of electricity consumption in Denmark; stopping of the nuclear program in Sweden), generally to replace electric heating systems by district heating grid (so, these schemes have a strong link with the chapter below) :

In **Denmark**, the Government subsidises the conversion of heating systems in old houses to district heating to reduce the energy consumption. Financial support is granted for the installation (to a maximum of 50% of the expenses) of district heating in old houses (i.e. houses built before 1950). The scheme runs until 2002. In 1996, 15.3 million € were granted<sup>42</sup>.

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<sup>39</sup> In East-Germany: Fördergesetz gemäß dem Steueränderungsgesetz 1991 vom 24.06.1991 und dem Standortsicherungsgesetz vom 13.09.1993

<sup>40</sup> From 1993 a new subsidy program was started for dwellings. For new-built single- or multi-family buildings the subsidy is in a form of a tax-deduction. For renovation the subsidy is lower than for new production. This "ROT"-deduction is a reduction of the tax with up to 30% of the labour costs, maximum 1 204 € per dwelling and it is planned to end after 1998. Also for owner-occupied dwellings in multi-family buildings there is a tax-deduction of 30% but the maximum amount is 574 €.

<sup>41</sup> Eigenheimzulage für Niedrigenergiehäuser

<sup>42</sup> Institute of Local Government Studies (AFK) – Denmark – Existing Policy Instruments in Denmark – 1998.

Also, the Electricity Saving Trust (Elsparefonden), a new subsidy for dwellings and public sector institutions, is aiming to convert the heating system in dwellings situated in areas with district heating. This subsidy is not limited in time. The budget is approximately 6.7 million €. The trust expects to be involved in the conversion of the energy supply to 50,000 houses from electricity to district heating or natural gas. This conversion is expected to take 10 years from 1998<sup>43</sup>.

From 1998, in **Sweden** there are subsidies to reduce the use of electricity for heating (it has been decided that the nuclear power production be phased out in the year 2010) and to promote the transition to other energy sources. There are in total 189 million € in the five-year program for dwellings.

There are three parts of the subsidy programme for:

- reducing the power of the use of electricity,
- changing from electricity heating to individual heating plant,
- converting from electricity heating to district heating,

The subsidy of reducing the power of electricity is maximum 1 147 € per dwelling, which may be used for equipment for local wood fired stoves and storage tanks together with a maximum power reducer. Only single- and two- family dwellings used the year around may get this subsidy<sup>44</sup>.

When changing from using electricity for heating to an individual heating system it is possible to obtain a subsidy of up to 3 441 € per dwelling. In this case a distribution system (water or air), a heating plant (for oil, gas or wood) and normally a chimney have to be installed.

When the building is situated in an area with district heating or planned for district heating it is not possible to get a subsidy for the measures above.

When the building is connected to a district heating system there are possibilities to get a subsidy for the needed installations, to a maximum of 3 441 € for buildings without an internal distribution system and maximum 918 € for buildings with an already installed water distribution system.

### 2.6.3.2.3 District Heating & CHP

Actually, district heating & CHP are not promoted by subsidies schemes so directly in European Union.

Except in **Finland, Denmark, Sweden** (where schemes for Switching fuels is in favour of district heating grid) and **The Netherlands** where there are subsidies for demonstration projects with new combinations CHP<sup>45</sup>.

And in **Sweden**, where the largest budget of investment subsidies (115 million €) was for bio-fuel power plants<sup>46</sup> (1991-1997). The subsidies, for reconstruction of existing district heating

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<sup>43</sup> Institute of Local Government Studies (AFK) – Denmark – Existing Policy Instruments in Denmark – 1998.

<sup>44</sup> Lund University – Dept. of Building Technology, Physics – Sweden – National analyses of existing instruments – 1998.

<sup>45</sup> In Finland this concerns the using of renewable energy sources.

<sup>46</sup> NUTEK 1993b

plants and combined heat power and district heating plants with fossil fuel, is 25% of investment costs, with a maximum 459 € /kW electric power<sup>47</sup>.

#### **2.6.3.2.4** Alternative fuels

Subsidies for alternative fuels are not detailed here because national and regional schemes present such different aspects that it would not be possible to give a relevant view of each of them.

But, the most important aspect is that all European countries support with more or less energy the two following renewable energy sources used for heating space which are solar thermal, wood and biomass for bio-fuels power plants. This is now a bit more expressed by the recent rising awareness of the risk of climate changes and the potential of a new market linked to the development of renewable energy sources.

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<sup>47</sup> Lund University – Dept. of Building Technology, Physics – Sweden – National analyses of existing instruments – 1998.

### 2.6.3.3 Standard products

#### 2.6.3.3.1 The boiler

In every European countries, the regulation applied to the **boiler** is the EU **Directive 92/42/EEC**.

In **Germany**, in general, new installed boilers have to be low-temperature boilers or condensing boilers (standard boilers can be installed except for very limited exceptions). This is required by energy saving laws (Heizungsanlagenverordnung).

Another Decree concerns the replacement before failure of existing boilers according to their heat losses. This Decree on small boiler (Kleinfeuerungsanlagenverordnung) defines deadlines for the replacement of existing boilers<sup>48</sup>.

The planned “Energieeinsparverordnung” defines that boilers installed before October 1978 have to be exchanged up to the end of 2005. Except for recent retrofitted boilers that to be exchanged until the end of 2008.

<b>Nominal power of boilers</b>	<b>100 kW</b>	<b>&gt; 100 kW</b>
<b>Exceeding of permitted losses by</b>	<b>Deadline for replacement</b>	
3 % or more	1/11/2001	1/11/1999
2 %	1/11/2002	1/11/2002
1 %	1/11/2004	1/11/2004

**In other countries, there is no obligation to replace the heating system (complete or partly) before failure.**

<sup>48</sup> Institut für Energiewirtschaft und Rationelle Energieanwendung – IER – Germany – Policy Instruments in Germany – 1998.



### 3 LABELLING

This chapter presents the different designs of labels already applied in the EU, some of them concern domestic boilers, others concern the whole building and therefore indirectly the heating systems. In a second and third part, the reasons and the difficulties to construct a label are described.

#### 3.1 Existing Label

##### 3.1.1 Labels on boilers and heating systems at EC level

The European Directive 92/42/CEE, article 6 defines a label concerning the energy efficiency for liquid and gaseous combustible fuel boilers. The label, with the four stars is used by few manufacturers in the European countries. This corresponds to a voluntary engagement.

The main disadvantages of the label, expressed by manufacturers, are detailed hereafter:

- the interval of 3 points between 2 levels is too low and incompatible with the measurement technologies (measurement uncertainty and repeatability) which do not allow a good classification of the boilers,
- the level of average temperatures of water (70 °C for Nominal Power (NP) and 50°C for 0,3 NP) is the same for all types of boilers (standard, low temperature, condensing), so the condensing ones are tested outside of the condensing phase, so they are under estimated.

Some manufacturers' opinion is that the minimum of interval points has to be 4 points. Indeed, the range of efficiency of boiler is very short (there is only 9 points between the lower and the highest values) which does not allow one to class the boiler according its efficiency without being influenced by the quality of the test and the uncertainty (around +/- 2%).

##### 3.1.2 At country level

The only countries with labelling schemes for heating systems are the United Kingdom and Denmark. The **United Kingdom** scheme is based on boiler performance which is specified by the SEDBUK efficiency<sup>49</sup> band described below :

<b>Band</b>	<i>SEDBUK range</i>
A	90% to above
B	86% to 90%
C	82% to 86%
D	78% to 82%
E	74% to 78%
F	70% to 74%
G	Below 70%

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<sup>49</sup> Note that these ranges are based on annual energy efficiency.

In addition there are four “Recommended Good and Best Practice”, called :

- CHeSS HR1: Domestic wet central heating system with regular<sup>50</sup> boiler and separate hot water store.
- CHeSS HC1: Domestic wet central heating system with combi<sup>51</sup> or CPSU<sup>52</sup> boiler.
- CHeSS HR2: Domestic wet central heating system with regular boiler and separate hot water store.
- CHeSS HC2: Domestic wet central heating system with combi or CPSU boiler.

Each “Recommended Practice” defines:

- a level of annual performance for boiler (see SEDBUK range table below),
- the minimum of technical features of control systems of heating system,
- the way to install.

### **In Denmark: the OR – Oil Boiler Scheme for Small Houses**

In 1978, the OR was introduced and is still running. All oil boilers with a power less than 120 kW must be cleaned once a year. Also a measurement of the efficiency must also be carried out and the result must be reported on a label on the boiler. The chimney sweeper controls the validity of the label. The system is mandatory and 85% (or 500,000 houses in 1994) fulfil the requirements. A survey with 1,200 OR houses and 100 non-OR houses found that the flue gas loss was 11% in average in the OR houses and 15% in the non-OR houses<sup>53</sup>.

**The Netherlands:** Highly efficient, condensing boilers can qualify for a "Gaskeur HR" label. Until 1997, this label was granted to boilers with energy efficiency above 88.5% on upper value, which equals 100% on lower value. Now, there are three different labels, corresponding to a minimum energy efficiency of 100, 104 and 107% on lower value, respectively<sup>54</sup>.

In some EU countries, labels have been developed by manufacturers or energy suppliers and are not presented here. However, those initiatives show that labelling is considered by commercial companies as an attractive tool for catching clients and as an efficient way of promotion.

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<sup>50</sup> The regular boiler has not the capacity to provide domestic hot water directly.

<sup>51</sup> A combi boiler has the capacity to provide domestic hot water directly, some models contain an internal hot water store.

<sup>52</sup> A CPSU boiler is a Combined Primary Storage Unit boiler with a burner that heats a thermal store directly.

<sup>53</sup> Institute of Local Government Studies (AFK) – Denmark – Existing Policy Instruments in Denmark – 1998.

<sup>54</sup> Dept. Of Science, Technology and Society – Utrecht University – The Netherlands – National Survey of Policy Instruments – 1998.

### 3.1.3 Building labels in the European Union

These labels<sup>55</sup> concern the whole building. In these labels, the heating system is a part of the labelling schemes which include also lights, appliances, cooking. The heating system is always included.

Mainly, the European norm EN832 on the calculation of the thermal performance of buildings is used. But, each scheme can complete the audit, allowing determining the level of label, by other calculation methods which are not described in the present document.

The present table show the different label according the country.

Country	Label Name	Application	Legal status	Organisation entitled to apply label	Period of check	Type of Label
Denmark	EM: Energy Rating Scheme	Small buildings (under 1500m <sup>2</sup> )	Mandatory	Consultant must be approved by the Danish Energy Agency	At time of sale	Letter M to A
	ELO: Energy Management Scheme	Large buildings (over 1500m <sup>2</sup> )	Mandatory for the owner		Annual energy management plan	
Ireland	HER: Heat Energy Rating	New dwellings	Market driven		At time of construction	
	ERBM: Energy Rating Bench Mark	New & old dwellings		NICER		
The Netherlands	EPA: Energy Prestatie Advies	Dwellings built before 1996	Voluntary request	Consultant must be approved by the specialised agency which controls the labelling agents.		

<sup>55</sup> This type of label is actually being studied for France, Finland and Belgium in the framework of SAVE contract n° XVII/4.1031/Z/99-261. Main data come from the interim report "Energy Labelling of Existing Buildings" of 1/8/2000 – International Conseil Energie – France.

United Kingdom	SAP: Standard Assessment Procedure	All dwellings	Mandatory for new buildings and Market driven	Authorised ratings can be obtained from approved companies	New houses at time of construction, social houses before upgrading, (proposed: existing ones at sale)	Number 1 to 100
	NHER: National Home Energy Rating			Commercial company owns label and authorises consultants		Number 1 to 100

According to the country, the main result of energy calculation can be different (this is the main difference between each scheme): useful energy, delivered energy, primary energy, energy cost, carbon emissions.

The form used to express the results of the calculations can be different too:

- total energy consumption : physical units, kWh,
- energy consumption by square metre : kWh/m<sup>2</sup>,
- total energy cost: monetary units,
- index based on real energy consumption / cost with comparison between types of house.

Content of Building Label<sup>56</sup>: All schemes of labelling include heating systems.

Country	Electric consumption	Electric pumps and fans consumption	Annual energy costs	CO2 emissions	NOx and SOx emissions
Denmark	Yes	Yes	Yes	Yes	No
Ireland	No	No	No	No	No
The Netherlands	Yes	Yes	Yes	Yes	No
United Kingdom	No for SAP Yes for NHER	Yes for SAP & NHER	Yes for SAP & NHER	Proposed for SAP	No

All schemes, except the Irish and UK ones, include measures and estimation of energy savings (expressed in energy consumption kWh or energy cost) and calculation of payback period .

<sup>56</sup> Some labels include also water consumption.

Each scheme is supported by accompanying measures, except in Denmark. The cost of labelling for the consumer is evaluated as follows..

Country	Cost of labelling (€) for the consumer
Denmark	EM: 300 to 450 - ELO: min 450
Ireland	HER: 30 to 150 - ERBM: 125
The Netherlands	EPA: 150 to 360
United Kingdom	SAP & NHER: 80 to 100

Other countries are studying a label for existing buildings in the framework of the SAVE Programme, with the objective to give information to the buyer about the level of energy consumption of the building. Belgium, Finland and France are concerned by this project.

**Two projects are being studied at EC level: an European Directive about Energy Performance of Building and a norm about Sanitary Hot Water. Those projects should be taken into account to go further into the future discussion on labelling of heating systems in dwellings.**

### 3.1.4 Label on household appliances

Presently, some household appliances (washing machine, tumble-dryer, oven,...) are communally labelled in European Union with the following index G to A (A: indicating the best practice). This presentation form is now used on all household appliances, and accepted by the consumer<sup>57</sup>.

Instead of the lettering system G to A, other scales are also used: 0 to 100; four or five stars.

Others information are given:

- physical unit (kWh, kWh/m<sup>2</sup>): may be easier to put in place but also not easy to understand by the consumer.
- monetary unit: appreciated by the consumer, but is very sensitive to the variation of energy price. And does not give a real idea of the quality of the installation.

Other information such as life time and investment/operating cost would be valuable for the consumer, but are so far not included in those Labels.

To be consistent with the other household appliances, it could be better to use the same meaning. The letters (G to A) commonly used must be the best solution to express the level of performance of the energy efficiency of the heating systems. This could be completed by the physical units which are, according to the level of description of the label, determined.

<sup>57</sup> The information given by the label may hard to understand by the consumer which is mainly interested by an information in cost. A survey by ADEME in 1995 shows some attempt from the consumer. The following information attempted by order of interest is:

- 1 - Consumption in values (€),
- 2 - Total annual energy consumption,
- 3 - Cost & evaluation of energy consumption individual items of equipment,
- 4 - Consumption according per unit area of the building.

## **3.2 Reason for constructing a labelling scheme**

The previous section on Market Actors show that one of the main barriers to the installation of energy efficient systems is the lack of information available to the different actors who take the decision: architects/building developers, installers, and ultimately final consumers. This lack of information inhibits the introduction of energy efficiency within the economical analysis, it is why the market is not oriented towards efficiency.

The main reason for labelling schemes is to overcome this barrier and to give information to the main deciders, and mainly to the final consumers.

Another advantage of the labelling scheme against other policy tools is to be able to concern both building markets: the new buildings, and the existing buildings, while the Thermal Regulation concerns only the new buildings market.

Another reason, introduced above, for trying to construct a label on heating systems is that consumers have now well accepted the concept for other equipment. Therefore, it is expected that a label based on the European Directive relative to the display of level of performance with letters G to A would be well received. However, this becomes a constraint for the label construction: it seems unreasonable to use another presentation.

## **3.3 Main difficulties in label construction**

Despite of the good reasons for constructing a label on heating systems, the section 3.1. shows that very few countries have initiated such a construction. This is due to a number of difficulties which appear when one tries to build a concrete solution.

### **3.3.1 Definition of the application field of the label**

The first difficulty for the elaboration of the labelling on heating system raises when considering the diversity of the systems and of energy used. Ideally, the label should allow to compare all heating systems, but indeed, it seems difficult to describe a label which could take into account all types of energy, technology and configuration of installation. The diversity of the situations is reflected in the section “Technical improvement and technology change”, which shows the extremely wide range of efficiency levels of heat generators, from 36% (old oil heater) to 121% (gas heat-pump).

It is why only gas and oil boilers, which are regulated by the actual European directive on energy efficiency 92/42/EEC, are taken into account in the labelling scheme proposed in section 6.

The energy efficiency of heating systems is influenced by several parameters:

- the technology of heat generation (boiler (condensing, low temperature, standard)...),
- the type of energy used (gas, oil, electricity, other...),
- the technology auxiliaries (pumps and fans),

- the double function of the heat generation (space heating and hot water production),
- the other components of the heating system (control systems if any, distribution network, emitters...),
- the connection to collective District Heating or CHP,
- the quality of services (installation and maintenance).

Heating systems are not household appliances as the other ones. Heating systems are composed of several components, and the evaluation of the boiler efficiency is not sufficient for characterising the global system efficiency. The multi-component side introduces an additional difficulty: many boilers are installed in buildings that can be old (2/3 of existing buildings in 2000 will still be in use in 2050). It means that a large part of heating systems are composed of recent boiler with old other components and particularly control systems, if any.

Another element of complexity is the dual use of a large number of heating systems, for heat and sanitary hot water production. The hot water production must be taken into account in the sizing of the boiler to respond to the consumer's needs. Besides, the heating system can be adjusted with a hot water store which increases the energy consumption to keep a nominal water temperature.

Another difficulty is to take into account the efficiency of auxiliaries (pumps and fans) in the case of liquid or solid fuels.

Other points of discussion are the level of training and qualification of installers, maintenance staff who maintain or replace the components of heating systems (mainly the boiler). Many of them don't use any procedure for boiler replacement and don't inspect the existing heating system. They rarely provide valuable advice about energy saving to the users.

Another key issue for energy efficiency is the consumer's behaviour. Even if it is not possible to include this issue in a label, the label should be used as an information vector, giving the opportunity to provide information about users behaviour.

It will not be possible in the present study to solve all these critical questions at once. It is why it is proposed in section 6 to show different steps to progress towards labelling of heating systems from a simple solution, which has the advantage to be applied easily with the help of boiler manufacturers, to a more complete solution, which needs further analysis and discussions.

It is shown in the section about the application of the four stars label proposed by the EC that the simplest system (a single boiler without any distribution system) is already the subject of a number of discussions and problems. A first step before progressing in labelling of systems would be to reach a common decision about the actual European Directive on the efficiency of liquid and gaseous boilers, which is not totally accepted by manufacturers. It seems that this is the first step to take, before taking into account other types of energy or other and more complex structures of heating systems.

### **3.3.2 Information to be included in the label and how to obtain it**

Even after having limited the field of application for the label, major difficulties appear when trying to find an agreement on a number of issues, mainly on the type of information to be delivered and that will be the basis for the label, linked with the way to determinate the level of the label.

Regarding the type of information that should be or could be delivered through the label, two main options may be considered. The first one describes the energy efficiency of the system, while the second option takes into account the consumption of the system. Both are not opposites and are supported by market actors; but according the option chosen, the label must take into account different parameters which will be displayed, so the information which are included in the label letter.

#### **3.3.2.1 Determination of efficiency**

If the label is limited to boilers, the efficiency can be determined in laboratories by a test procedure, allowing the classification of the boilers according to the technology and independently of any other consideration.

However, the experience from the EC four stars label shows that it is difficult to class different technologies (standards, low temperature, condensing), and a procedure of tests must be defined to ensure the repeatability of the results. Besides, when defining the different classes, one must take into account the measurement uncertainty which may reach 2%.. Actually, this is a major point of discussion about the European star label.

Another parameter having an impact on the measures is the quality and the nature of fuel used. The energy efficiency of gas boiler or oil boiler is different. Even for condensing technology, best oil boilers (for example: 100,8% for a power of 20kW) are under the best gas one (105,3% for a power of 20kW). This is due to the value of PCI<sup>58</sup> reference used which is the value of gas.

Moreover, it must be noted that the conditions of test in laboratories don't correspond to the real condition of use. Indeed, measures are carried out at nominal and part load charge (30%), which is not the level of charge in all European countries.

But, even if the efficiency at a lower level of charge can be determined by calculations. So, the level of part load, used to determined the efficiency during tests, has not to be changed.

The tests in laboratory can measure only the efficiency of the single boiler and a suitable methodology must be designed for taking into account the other components of the heating systems. Such a methodology is proposed in section 6.

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<sup>58</sup> The PCI values of fuel are not equal: the maximum theoretical efficiency of oil is 107% ; gas is 111%.



### 3.3.2.2 Determination of consumption

Instead of delivering information on efficiency, an option is to deliver the energy consumption, then the energy cost, which would be a very clear information for the final consumers. Besides, it would allow the comparison of very different heating systems.

However, this requires to take into account:

- climate conditions,
- features of building (size, quality of insulation...),
- efficiency at nominal power (corresponding to the hot water production),
- number of occupants.

This information is very difficult to characterise. Indeed, the needs of heat are different in each European country (even within a same country, different climate zones may be defined by national Thermal Regulation) and the attitude of the consumer is also different according to the European country. So, **if the label must detail an annual consumption of energy, the conditions of test have to be defined strictly by the way of cases of reference**, eventually corresponding to national climate conditions, features of buildings or other appropriate information.

Considering all those difficulties, the scheme proposed in section 6 is mainly based on providing information on efficiency of boilers plus a method for taking into account the other components of the complete heating system.

### 3.3.3 Additional constraint for a label at EC level

At a country level, the construction of a label on heating systems has already to face difficult questions. At EC level, an additional constraint will be to be compatible with the different national regulations.

## 4 CONCLUSION

In the field of heat systems based on oil and gas boilers, efficient technologies are mature but their dissemination does not reflect the potential level of efficiency. Different tools have been implemented by governments in each EU member state. The situation is very different from a country to another one, which comes for a part from the different geographical situation, then from a different level of concern. This contrasted situation makes difficult the construction of common tools compatible with every national context.

Installers, architects, building developers and consumers are the main actors of the heating market particularly in the decision process for individual heating systems in dwellings. Architects and buildings developers are the main responsible actors in the case of new buildings. Their choice is widely influenced by the energy suppliers and/or the manufacturers. In existing buildings, the choice of the consumer is still influenced by the installer who generally does not consider energy efficiency as a first priority. Indeed the consumer is still not enough or badly informed. So he is not able to take his own decision, even if he is the final user of the heating system.

The economical barrier, coming from the high cost of efficient technologies, have been often recognised and treated through the use of subsidies and fiscal incentives.

In the past, several programmes of subsidies were developed by respective national governments regarding energy efficiency of heating systems and particularly for efficient boilers. But, at present, there is no specific programme of subsidies at country level to promote efficient products in individual heating systems. However some countries use fiscal tools as tax reductions, and others types of subsidies may come from energy suppliers.

District heating & CHP and Switching fuels are promoted by subsidies schemes in few European countries.

Another possibility to promote efficient products and clean fuels could be to reduce the VAT.

The two main regulations regarding the level of energy efficiency of heating systems, are the European Directive 92/42/CEE, applying to liquid and gaseous fuels boilers, and the national Thermal Regulations or Building Codes applying to the new buildings, in which the European Directive on boilers is included.

However, manufacturers are making products of which energy efficiency is higher than required in the European Directive, and it could be possible to define a new level of requirement.

Some efforts are made in some countries to impose the installation of condensing or low temperature boilers.

Moreover, except for few countries, there is no regulation on the procedure for installation or for replacement of boilers in existing dwellings. This is particularly unfavourable, if it is not a lack, to proper sizing of a boiler according to the real heating requirement in the dwelling and to determine the correct replacement according to the others components of the heating system (mainly the emitters which must be adapted in the case of low temperature and condensing boilers).

One general barrier in all countries is the lack of information available to the main actors in the market chain, and particularly to the final consumers. It must be reminded here that in most cases, the final user does not decide by himself about the system to be installed.

Therefore, those who decide do not pay for the consequences of the decisions, which is obviously a major constraint for an efficient market. In order to overcome this barrier, both options are offered to the authorities:

- imposing efficiency through norms and standards,
- giving information to the final consumer, making him able to evaluate what he is buying or renting, then creating a positive pressure on the whole market actors.

Both options are not opposites, and on the contrary can be used in a complementary way. The regulations could be used for imposing a minimum efficiency, and information tools would allow to obtain even better efficiencies.

In this context, the construction of a label appears as attractive:

- it provides the required information to the final user,
- labels are already developed for a number of households appliances, and are accepted by the European consumers.

However, heating systems, which in most EU regions represent the main share of energy consumption in a building, are not regulated by a label. This comes from constraints specific to heating systems:

- the wide range of systems: different fuels, different sizes, different configurations,
- the complexity of a heating system, much higher than in the case of single appliances. This creates high difficulties for defining and evaluating a criteria for efficiency.
- a label at a EU level may present additional constraints: it must be adapted to all different national regulations, and to different geographical regions.

Even in the case of boilers only, the four stars label proposed within the European Directive faces some difficulties to be used.

Two projects of European Directives about Energy Performance of Building and the Sanitary Hot Water norm are being studied.

Besides, several labelling schemes of existing buildings are already implemented or under study at state level in different European countries.

These projects should be taken into account to go further into the future discussion on labelling of heating systems in dwellings.

This brief analysis allows to determine some conditions that will be the basis of a proposal for a label on heating systems. This proposal is the subject of section 6. The conditions can be summarised as follow:

- the application field will be limited, at least in the first steps, to heating systems based on gas and oil boilers,
- the information to be delivered will be the efficiency of the system (even if the option of delivering information on actual consumption would appear as more valuable for the consumer, it faces too complex questions),
- the basis will be a label on efficiency of boilers only, and the experience from the EC four stars label shows that this first step is not easy to design. Then, a specific methodology will allow to take into account the other components of the heating system, as well as conditions for installation.

A label for boilers and heating systems, should ideally be extrapolated to the whole building, including the envelope.

The label would be compatible with other tools that might be put in place to support it, where the market is not able to promote the efficient product by itself, for instance subsidies on efficient products. Besides, a specific attention should be addressed regarding the consumer who are not financially able to invest in efficient products.

From this perspective, the application of labels to gas and oil boilers should result in the improvement of the energy efficiency of heating systems in dwellings. But this labelling does not cover all possible cases. Collective and other types of heating systems could be regulated by labels, even if the method to determine a label can be difficult to construct, and even if the interest of the consumer is indirect. This supposes, for more complex heating systems a wider view on the building, its features and the climate conditions.