Deliverable 3.1

Country Specific Factors - Report of Findings in WP3

Pekka Tuominen & Krzysztof Klobut

VTT Technical Research Centre of Finland

Project:	**Improving Dwellings by Enhancing Actions on Labelling for the EPBD**
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Summary

Improving Dwellings by Enhancing Actions on Labelling for the Energy Performance of Buildings Directive (IDEAL EPBD) is a project co-funded by the European Union under the Intelligent Energy Europe Programme. The project will run from October 1, 2008 until October 1, 2011 and has project partners in ten European Union (EU) countries. These countries are: Denmark (DK), Germany (DE), United Kingdom (UK), the Netherlands (NL), Belgium (BE), Finland (FI), Portugal (PT), Bulgaria (BG), Latvia (LV) and, Czech Republic (CZ).

The project aims to monitor and evaluate consumers' response to the energy labelling of domestic dwellings.

In the IDEAL EPBD project, Work Package 3 was set up to gather information on:

- the current housing stock in the participating countries
- the barriers to energy saving and
- the policy measures set up to overcome these barriers.

In addition, an estimate of energy saving potential has been calculated based on the housing stock information.

These results will inform the in-depth interviews (WP4) and web based questionnaires (WP5) carried out later in IDEAL EPBD. The results will also be useful when developing policy recommendations.

The implementation of EPBD was complete or close to completion in all the countries. The most commonly reported public policy measures in use were ones relating to information dissemination and subsidies for energy efficiency retrofits. Regulations, ecological taxation, subsidies for renewables and Research and Development (R & D) activities were also commonly cited.

In most countries, a large number of separate programs and initiatives were cited. Some form of coordination between these initiatives leading to a more strategic approach to energy efficiency seems to be missing in most countries. Many stakeholders and professionals mention in the interviews that a common problem for consumers is finding neutral, unbiased information. Als noteworthy is that little attention seems to be given to specific training efforts to improve the skills of the people implementing the energy efficiency improvements, even though the lack of skills was a commonly cited barrier to further improvements.

Based on the results of the questionnaires concerning the housing stock in the participating countries, a preliminary estimate of energy savings potential has been calculated. The greatest savings potential can be found in Germany, this is expected because of its large housing stock. In relative terms the highest savings potential appears to be in Bulgaria, where there are ample opportunities to save energy and the cost of renovations appears to be lower than in most other countries.

In general, it seems that cost effective energy savings of about 10% can be achieved by 2020 in most countries and 20% by 2030. A total annual energy saving of approximately 150 TWh by 2020 and 280 TWh by 2030 appears possible. This can be compared to the total annual primary energy consumption of 21 000 TWh in all EU countries combined.

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1 Introduction

1.1 Background

Article 7 of the Energy Performance of Buildings Directive (EPBD) states that domestic buildings which are <1000m^2 must have an Energy Performance Certificate (EPC) when they are sold, rented out or constructed. The EPC includes a label rating the energy efficiency of the dwelling and recommendations of cost-effective energy saving measures. The basic idea of the certificate is that it assumes that household's decision processes are based on financial savings and by informing the household about cost effective energy saving measures this will result in marked behavioural change. However, as there is no obligation to carry out the recommended saving measures, it is unclear to what extent energy savings will be realised in existing buildings (<1000 m^2) due to the EPBD.

Experiences with prior labelling/auditing programmes show that not all cost-effective saving measures are carried out. If these earlier experiences form an indication of the effectiveness of the EPBD, a risk exists that a large part of the energy saving potential in existing dwellings will not be realised under the EPBD.

Therefore the role of Work Package 3 (WP3) is to explore the country specific factors that affect energy efficiency in each participating country (DK, DE, UK, NL, BE, FI, PT, BG, LV, CZ). The results can then be used to draw lessons on what does and what does not work when countering the barriers to energy efficiency in domestic dwellings.

1.2 Objectives

In the IDEAL EPBD project, Work Package 3 aims to gather information on:

- the current housing stock in the participating countries
- the barriers to energy saving and
- the policy measures set up to overcome these barriers.

The result will be analysed to identify which barriers are perceived to be most common and important by professionals in the participating countries and what policies have been established to overcome the barriers.

In addition, an estimate of the energy saving potential has been calculated based on the housing stock information. These results can be used as a baseline to monitor the effectiveness of the EPBD.

The success of EPBD certification and thus of the EPBD itself, depends to a large extent on the conditions in Member states (MS). In WP3 both technical and institutional country specific characteristics will be inventoried. The output of WP3 will be used to adapt the in-depth interviews (WP4) and online questionnaires (WP5) to local circumstances. Furthermore, the inventory of WP3 will be used as input for WP6 to design country specific policy recommendations. The relation of WP3 to other parts of the IDEAL EPBD project is illustrated by Figure 1.

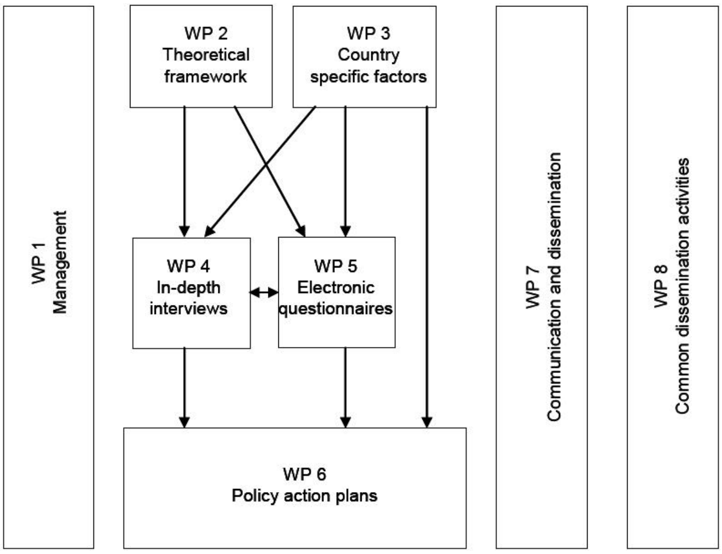

Figure 1 WP3 in relation to other parts of IDEAL EPBD.

1.3 Scope

The project is limited to residential buildings in the ten participating member countries. Specifically, the size, composition and energy consumption of the housing stock and the barriers and policies pertaining to energy efficiency in each country were studied.

IDEAL EPBD focuses on existing, privately owned dwellings because:

- Consumer behaviour is especially relevant and determines what action takes place in this part of the housing stock,
- Private dwelling owners is a target group that is hard to reach for policy makers (much more difficult than housing cooperatives or municipalities - often owners of rental dwellings) and
- Privately owned dwellings form a large part of the dwelling stock in Europe: 71%.

2 Methods

2.1 Housing Stock Inventory

The inventory of housing stock was compiled from data collected from each of the IDEAL EPBD research teams in each participating country. Each country provided their respective stock data including, but not limited to, the following information:

- Size of housing stock categorized by two general types of buildings: single-family houses and apartment buildings, dwellings were also grouped by age (different bands were used by most countries).
- Past and expected rates of renovations aiming at improving energy efficiency of homes
- Types and costs of different energy enhancement measures, etc.

The inventory thus formed the basis for calculating the expected saving potential under the EPBD for existing dwellings and provides insight into total cost-effective saving potential in dwellings that are <1000 m^2. The results can be used as a baseline to monitor the effectiveness of the EPBD.

2.2 Calculating Baseline and Savings Potential

The data on the housing stock collected from each participating country provided a baseline for the saving potential for existing dwellings. The calculations were carried out in the following order, for each country separately based on local data:

1. Data on the age of buildings and their respective heating energy consumption was used to calculate the present energy consumption to be used as a baseline. Data on buildings were categorised into a number of age bands by each participating country and this enabled the calculation of $Q_{heating}$, which is, the annual amount of energy used for heating.

   $$Q_{heating} = A \times Q_{specific}$$

   where A is the floor area of the buildings in the said age group and $Q_{specific}$ is the average specific heating energy consumption per unit of area in the same group.

2. For each type of energy efficiency improvement, an effect on the energy consumption and a price for the improvement was acquired from the various countries. The costs of each improvement were annualized for ten years with an interest rate of 10 % with the equation

   $$R = P_{total} \Bigg/ \frac{1 - \frac{1}{(1+i)^n}}{i},$$

   where R is the annualized cost of the improvement, P_{total} is the total cost of the improvement when it is done, n is the number of periods, that is ten years, and i is the interest rate 10 %. This 10% is typically used in cost-effectiveness calculations as a figure higher than the inflation rate and lower than in most of the consumer credits [1]. To get a price for the energy saved, the annualized costs R were divided by the annual energy savings Q_{saved} of the improvement in question:

   $$P = \frac{R}{Q_{saved}}.$$

3. For each country, the price of energy saved *P* (results from step 2) were compared with local electricity prices. When the cost of energy saved was lower than the price of electricity, an improvement was deemed cost-effective.
4. For each age-group of buildings it was calculated how much energy consumption would fall, if the cost-effective improvements (determined in step 3) were implemented at the expected autonomous renovation rate. Since these renovations would occur in any case, the price for efficiency improvements is substantially lower than if implemented autonomously.

   For each age group *j* the new energy savings $Q_{saved,annual,j}$ achievable each year will be the product of the autonomous renovation rate *r*, the total area of that group *A* and specific energy savings of the improvements deemed cost-effective for that age group $Q_{saved,specific,j}$.

   $$Q_{saved,annual,j} = r \times A \times Q_{saved,specific,j}$$

   Summing all *n* number of age groups *j* in the country *c* we obtain the total new annual energy savings $Q_{saved,annual,c}$:

   $$Q_{saved,annual,c,j} = \sum_{j=1}^{n} Q_{saved,annual,j} \; .$$

5. Cumulating savings from step 4, an estimate of savings potential $Q_{potential,c}$ for a given year *y* in the country *c* can be derived:

   $$Q_{potential,c} = \sum_{j=1}^{y} Q_{saved,annual,c,j} \; .$$

   Naturally summing for *c* additionally will give the total savings potential $Q_{potential,total}$ for the set of all ten countries:

   $$Q_{potential,total} = \sum_{c=1}^{10} \sum_{j=1}^{y} Q_{saved,annual,c,j} \; .$$

Such calculations rely heavily on average values for a large amount of buildings that are, in reality very different. Therefore the results should be regarded as cursory estimates of a potential development, rather than exact forecasts.

2.3 Inventory of Barriers

Energy Performance Certificates provide consumers with recommendations for cost effective measures to improve the energy efficiency measures in their home. However, there is a general consensus that consumers do not take forward these measures. The inventory of barriers explores which barriers are perceived in each country. This an important stage in order to find effective ways to overcome both country specific and general consumer barriers. Some of the key barriers are: financing facilities, knowledge, the quality of the building stock, construction sector skills, institutional and legislative factors (e.g. how is the EPBD implemented and where does it differ from outcomes of the concerted) action), the role and skills of stakeholders.

In WP3 the research teams in each country interviewed local stakeholders (including policy makers) face to face or by telephone to find out what main barriers they perceive in their country, what their needs are and what experience they have had so far with the EPBD. The interviewees were mostly professionals such as directors of ministry departments, housing agencies, construction associations, renovators of buildings and policy makers. On average 5.75 people were interviewed per country. The results were delivered to the VTT research team in forms, where the barriers were categorized by type and supplemented with information on the sources for the data and polices already implemented, if any. The categories for barriers were:

- Regulations. These are government regulations that hinder improving energy efficiency for example by giving wrong incentives.
- Financing. This is sometimes called the liquidity constraint and refers to significant restrictions on capital availability for potential borrowers who would invest in energy efficiency.
- Market structure. A variety of market structures have been identified as likely to reflect unstable or unequal bargaining positions. These structures refer to markets in which there are either one (monopoly, monopsony) or small number of either sellers (oligopoly) or buyers (oligopsony) and large number of the other, correspondingly.
- Imperfect competition. Occasionally product supply decisions made by manufacturers may affect the market situation. This kind of barrier suggests that certain powerful firms may be able to inhibit the introduction by competitors of energy-efficient, cost-effective products.
- Principal-agent problems. They arise when economic benefits of energy conservation do not accrue to the person who is trying to conserve. A typical example in the real estate industry is between landlords who do the investments and tenants who pay the energy bills. The former has little interest in investing in energy efficiency to benefit the latter.
- Negative externalities. Energy use entails a number of harmful effects to people and the environment that are not included in the price of the consumption. Any harmful effects that are not taken into account in prices are called externalities. For example heating with wood emits particular matter that can cause adverse health effects. Since this negative effect is caused to others and the person doing the heating pays no price for it, it is considered to be a negative externality. If environmental and other externalities are not fully addressed by environmental policy, the resulting level of energy efficiency is likely to be too low.
- Imperfect information. In order for energy efficiency to improve, the potential actors must be informed about potential investments and other types of improvements they can apply to their energy consumption. Ideally, information is perfect and costless, including knowledge of current and future prices, technological options and developments etc. A series of information market failures have been identified as inhibiting investments in energy efficiency: the lack of information, the cost of information, the accuracy of information and the ability to use or act upon information.
- Information as a public good. A consumer or a company that develops or implements a new technology typically creates benefits for the others and, hence, has an inadequate incentive to invest. Others get the benefits but avoid the cost of learning. This may lead to underinvestment in research and implementation of new technology.
- Other barriers.

However, as can be seen from section 3.3, the categorization was redesigned for this report as some barriers commonly reported fitted poorly to the predefined categories.

2.4 Inventory of Policy Instruments

The aim of WP3 is to analyse the effect of consumer barriers on energy conservation and compare result in various countries and various policy measures to identify the most effective ways to solve market barriers and to change consumer behaviour. These insights will later be used to design country specific policy recommendations.

Labelling of existing dwellings smaller than 1000 m^2 is not yet mandatory in all the countries, whereas some countries have already a long history of labelling and audits of existing dwellings. Half of the IDEAL EPBD project team comes from countries with prior experience (DK, DE, UK, FI, NL). The rest of the project team comes from different regions in Europe (BG, LV, CZ, PT and BE) in order to include as much geographical difference as possible.

The research teams in each country were asked to provide an inventory of the policy instruments already in place. Forms were developed and provided for delivering the results. The methods for gathering them varied and usually included literature reviews and interviews. Each policy instrument was categorized by type and data from the barrier inventory was linked to see which barriers they were designed to address.

The categories for policy instruments were:

- EPBD,
- Policy processes and strategic planning,
- Regulations and standards,
- Finances and taxation,
- Incentives and subsidies,
- Public investment,
- Energy audits and voluntary agreements,
- Methods and software,
- R&D,
- Education and outreach and
- Other policy measures.

Experiences on existing labelling schemes and the current status of EPBD implementation were also charted. Some ill-devised policy instruments can themselves act as barriers. The forms also included this type of barrier, and many countries reported such barriers.

3 Results

3.1 Baseline of Energy Efficiency

The baseline for energy efficiency in each country depends largely on two parameters: the energy consumption in the residential building types present in the housing stock and the size of the housing stock.

Based on the data reported by IDEAL EPBD participants from each country, weighted averages for heating energy consumption were calculated for two building types: single family houses and apartment buildings. In this context, separate houses owned and occupied by only one family belonged to the category single family houses. All the other types of dwellings (attached houses, blocks of apartments, etc.) were grouped in the category apartment buildings. Average heating energy consumption varied between 96 kWh/m^2/a in apartment buildings in Bulgaria and 273 kWh/m^2/a in houses in Latvia. These results and the sizes of residential building stock are shown in Figure 2.

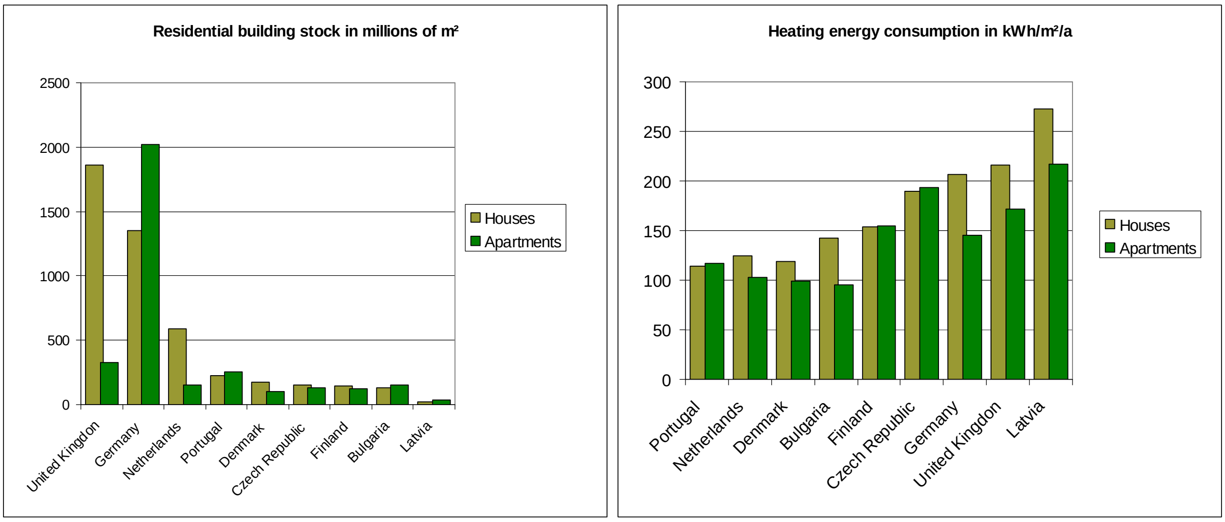

Figure 2 Size of housing stock in each country and the weighted average of heating energy consumption in each country.

The results show, that the existing stock of single-family houses in the ten countries consume 877 000 GWh of energy for space heating annually. For apartment buildings, the consumption is 474 000 GWh annually.

3.2 Savings Potential

As can be expected without any calculations, the countries of IDEAL EPBD are bound to have very different savings potentials. As can be seen from Figure 2, countries with a large inventory of buildings probably hold the largest savings potentials in absolute terms, namely Germany and the United Kingdom. On the other hand, based on average consumption numbers, some countries are likely to have large potentials for savings on national level, but their relative contribution to the European total will remain small nevertheless. Such is the case of Latvia, for instance.

Savings potential in each country was evaluated as was explained in section 2.2. An annual rate for energy efficiency retrofits in each country was calculated based on the renovation rate typical for each country and the set of applicable cost-effective energy efficiency measures. The effects of these will accumulate to produce the total savings by years 2020 and 2030, see Figure 3.

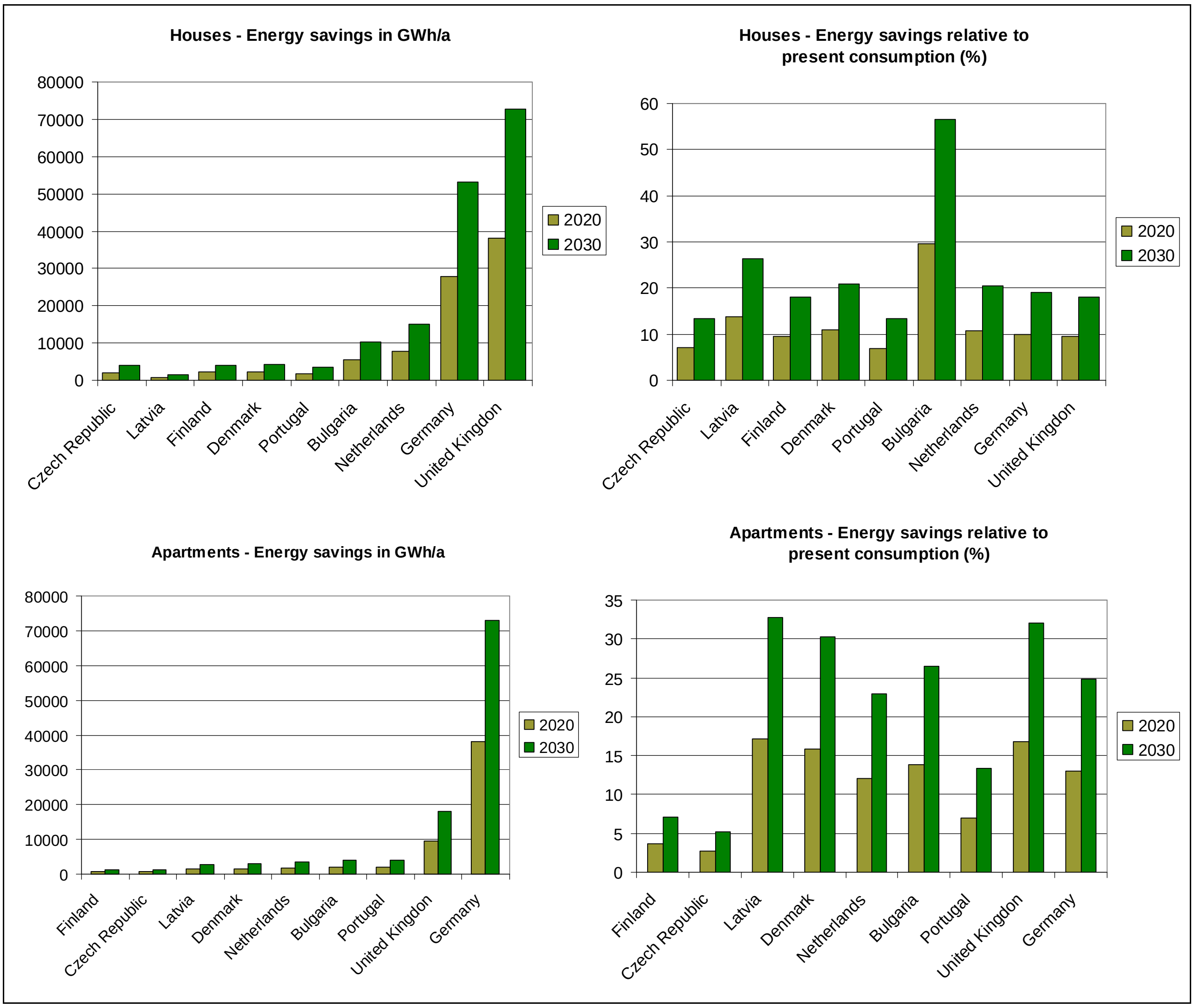

Figure 3 Energy savings potentials.

Summing up the results for all ten countries, 88 TWh/a could be saved in single family houses by the year 2020 and 58 TWh/a in apartment buildings, totalling 146 TWh/a. By 2030 similar figures are 169 TWh/a for houses and 110 TWh/a for apartments, totalling 279 TWh/a for all dwellings. In relative terms the potential represents around 10 % by 2020 and 20 % by 2030 of present heating energy consumption.

These results are on the par or even rather conservative compared to other studies. The Action Plan for Energy Efficiency [2] reports an estimated saving potential in the buildings sector of 28 % in 2020, of which 91 Mtoe in the residential sector. Furthermore the plan points that the Energy Performance of Buildings Directive (EPBD) can play a key role in realising the savings potential in the buildings sector.

World Business Council for Sustainable Development recently published the study Transforming the Market: Energy Efficiency in Buildings [3] that asserts a 60 % reduction in energy use in buildings as being possible by 2050. The rate of improvement deemed possible here and in the Action Plan for Energy Efficiency would eventually lead to such levels of reductions.

3.3 Market Barriers

This section provides a summary of the market barriers reported by the stakeholders interviewed in countries participating in this study. Some of the more uncommon barriers are omitted. The complete country profiles are provided in the Annex I to this report. Please note that the following results and statements are based on the statements from the stakeholders in the interviews, not on empirical analyses of dwelling owners opinions or behaviour.

The countries were asked to report the market barriers in nine categories, as explained in section 2.3. However, it became evident that some barriers commonly reported fitted poorly to the previously defined categories. Therefore the barriers have been recategorized in this report into four classes: regulatory barriers, barriers related to organizations and decision making, financial barriers and barriers related to information, promotion and education.

3.3.1 Regulation

Nearly all countries reported at least some barriers that were related to government regulation or its enforcement, as can be seen from Table 1. Most commonly mentioned was insufficient or too lax regulation that left some key problems unaddressed or did not set demands to buildings high enough. Two countries reported problems with supervision and enforcement of regulations, while three had problems with frequent regulatory changes.

Badly designed incentives distorted the development of energy efficiency in some countries, and in many cases consumers had to deal with unclear or insufficient regulations relating to EPBD labelling. Some complained also about a high price or low visibility for EPBD labelling.

Table 1 Barriers reported by the member states related to regulation.

	BG	CZ	DE	DK	FI	LV	NL	PT	UK	sum
Insufficient or lax regulation				x		x	x	x	x	5
Incentives not working properly	x		X			x	x	x		5
Unclear regulations about labelling	x		X			x	x			4
Insufficient subsidies					x	x	x			3
Price of labelling				x			x	x		3
Frequent changes in regulation	x		X				x			3
Visibility of labelling				x					x	2
Lack of supervision and enforcement	x			x						2

Some of the problems with regulation seem to be related to mere good governance. The problems caused by erratic policy changes, for instance, could be avoided simply by better planning. Moreover, lack of supervision and enforcement should also be seen as a matter of good governance.

The question of too little or too much regulation and subsidies is, of course, a more complicated one. In any case any regulation and subsidies should be designed so that they send the correct signals.

3.3.2 Organizations and Decision Making

Some countries reported no barriers related to the decision making process in buildings and among the actors contributing to energy efficiency, as can be seen from Table 2. Considering the ubiquity of such problems, it seems likely that they might not have come up in the interviews, rather than be missing from the said countries. These barriers are closely related to the informational barriers discussed in section 3.3.4.

Many respondents felt that complications of decision making in housing companies, such as majority rule, lead to useful improvements going unimplemented simply because when no decision is reached inaction is the default result. Also, the many actors of efficiency improvements – the dwellers, the government, the designers of the improvements, the renovators – encountered problems with communication and coordination.

Table 2 Barriers reported by the member states related to organizations and decision making.

	BG	CZ	DE	DK	FI	LV	NL	PT	UK	sum
Decision making process in buildings	x			x		x				3
Lack of communication and coordination	x			x					x	3
No building level coordination	x					x				2

It seems natural that the variety of actors should find it difficult to efficiently communicate and act together. This could be facilitated perhaps by devising products and creating business models where improvements could be purchased as complete packages on a turnkey basis. This would probably also ease the problems of decision making in the housing companies.

3.3.3 Financing

Most countries reported problems with financing. It seems probable, again, that the two countries not reporting any barriers in this category, the Netherlands and the United Kingdom, had no related responses in the interviews rather than not have any barriers. The most commonly cited financial barriers are shown in Table 3.

Table 3 Barriers reported by the member states related to financing.

	BG	CZ	DE	DK	FI	LV	NL	PT	UK	sum
EE has no effect on price or rent of dwelling	x	x	x	x		x		x		6
Lack of appropriate, affordable financing			x	x	x	x		x		5
Negative externalities not fully internalized	x	x		x				x		4
Low incomes	x					x				2
Sharing of costs among occupants	x				x					2

The most common barrier seems to be that energy efficiency improvements do not raise the value of the property or the rent it provides. In some countries, such as the Czech Republic, this may be due to a price ceiling in rents but in most cases regulated pricing cannot be the reason. It is not entirely clear why potential buyers or renters would not value improvements that save them money in energy bills. The phenomenon might be related to a lack of information about the effects of energy efficiency.

On the other hand, another important explanation could be that house owners and buyers are predominantly interested in the "visible characteristics" like the type, arrangement and age of for instance the kitchen or the bathroom, the size of the house, the number of rooms, and - more generally - the physical condition of the house. Energy consumption and energy efficiency is simply not placed high on the agenda of house buyers - and as a result of this, there is only a very limited correlation between efficiency standard and prize.

Another commonly reported barrier was the lack of financing for energy efficiency improvements. This problem should be possible to address with the designing of a suitable financial instrument, an energy efficiency investment loan of some sort. After all, the improvements discussed here are ones that are economically viable in the sense that they save more in terms of energy costs than cause investment costs.

Furthermore, Bulgaria and Latvia reported that the low income of people prevented improvements. This, however, can be seen as a form of lacking financing instruments since no matter how low one’s income is it always makes sense to make cost-effective investments. The cost of profitable energy efficiency investment should be recoverable from the savings in energy bills as long as suitable financing is available.

The fact that negative externalities, such as the pollution caused by most forms of heating, directly or indirectly, are not included in the prices of energy, was commonly cited as a barrier.

Some countries reported that the fair sharing of renovation costs with the occupants of a building presented a problem. This is closely related to the problem of communal decision making discussed in section 3.3.2.

3.3.4 Information, Promotion and Education

As can be seen from Table 4, among the more prolific barriers are the ones related to information, promotion and education. All of the countries reported at least some barriers in this type. It seems that in general, people are ill informed about energy efficiency, regulations, financing and technology. This can also be seen as a sign of poorly designed products since if energy efficiency investments were presented simply as a combination of a lump sum payment now and regular earnings later in the form of energy savings, certainly they would not be too complicated to fathom for anybody.

Table 4 Barriers reported by the member states related to information, promotion and education.

	BG	CZ	DE	DK	FI	LV	NL	PT	UK	sum
Low priority of EE	x	x		x			x		x	5
Lack of neutral information			x	x		x	x		x	5
Lack of awareness about technology	x	x						x	x	4
Poor training, skills and specialization of professionals	x	x			x			x		4
Lack of information about EE						x	x	x		3
Difficulties in influencing builders		x			x					2
Lack of awareness about regulations	x			x						2
Lack of research and information on results	x					x				2
Lack of financial understanding (payback times, etc.)							x		x	2

As it is, however, energy efficiency seems to be a low priority to people. They are perceived to be not aware of related technologies and to find it difficult to find neutral, unbiased information about it. Governments often have difficulty finding efficient ways to communicate energy efficiency policies to the actors in the market. Therefore, it seems that there is a need for the dissemination of neutral information about energy efficiency. Certainly this looks like a problem that governments could have a role in solving, by doing research and providing information, guidelines and recommendations.

Also, gathering the different products available in the market place to one place, such as a website, where consumers could evaluate and compare them would reduce the arduous process of going through the myriad products usually provided by small and medium-sized companies.

Finally, there is a shortage of skilled, well trained, specialized professionals who could implement the energy efficiency improvements. It is noteworthy, that many countries reported a lack of skilled labour but very few reported educational programs aiming to overcome this shortage.

3.4 Policy Measures

This section provides a summary of the policy measures reported by the countries participating in this study. The most uncommon policies are omitted. The complete country profiles are provided in the Annex II to this report.

The countries were asked to report the policy measures in eleven categories, as was explained in section 2.4. However, some policy measures commonly reported fitted poorly to the previously defined categories. Therefore the policies have been partially recategorized in this report into the twelve classes shown in Table 5.

Table 5 Policy measures reported by the member states.

Policy measures	BG	CZ	DK	DE	UK	FI	LV	NL	PT	sum
EPBD implemented	x		x	x	x	x	x	x	x	8
Subsidies	x	x	x	x	x	x	x	x		8
Information and tools		x	x	x	x	x	x	x	x	8
Regulatory demands			x	x	x	x	x	x	x	7
Ecological taxes		x	x		x	x		x	x	6
R & D programmes	x		x	x		x		x	x	6
Funding for favoured energy sources		x	x	x	x				x	5
Action plan or strategy for EE	x			x		x		x	x	5
Certification or classification	x			x		x				3
Energy audits and voluntary agreements						x	x	x		3
Training and education	x			x			x			3
Credit facility	x			x						2

All of the participating countries, except the Czech Republic, reported that the implementation of Article 7 of the EPBD directive was completed in their country. The Czech Republic expect the implementation to be completed in 2009 or at the latest in 2010. Eight countries reported other regulatory demands in addition to EPBD.

Nine out of the ten countries offered subsidies for energy efficiency and had some sort of information campaign established. In five countries one or some energy sources were favoured over others when distributing subsidies. Moreover, most countries employed some form of ecological taxation, usually in the form of energy taxes.

A Dutch peculiarity was preferential taxation of investments in “green funds”, funds that concentrate on ecological investments. Germany was the only country that reported that the government pays attention to energy efficiency in its own building investments such as social housing projects. This would seem to be a very direct way for governments to promote energy efficiency and should be considered for adoption in other countries.

4 Discussion

Surprisingly few of the responses included descriptions of strategic planning on a national level in advancing energy efficiency. Instead a great number of separate programs and initiatives were cited. This is striking given the importance of energy efficiency at EU level and also in the political discourse in the member states.

Some of the problems with regulation seem to be possible to solve with mere good governance. The problems caused by erratic policy changes, for instance, could be avoided simply by better planning.

In general the question of too little or too much regulation and subsidies is, of course, a more complicated one. In any case any regulation and subsidies should be designed so that they send the correct signals. Golove and Eto [4] have argued that there are three economically sound rationales for governments to intervene:

- To counteract the effects of market failures,
- To reduce transaction costs, and
- To help individuals help themselves.

Many of the policy measures in place now do not correspond clearly to any of these three rationales. In these cases one should evaluate whether money and effort could be more efficiently used elsewhere to promote energy efficiency. On the other hand many clearly effective policy measures are still missing from some of the countries.

For example many countries lack voluntary energy auditing and conservation programs for the construction industry and building owners. This would seem to be a risk-free and quick policy to adopt and therefore a good place to start for countries with few policies to start with.

In some of the new member states there are great difficulties in deciding about measures applied to apartment buildings because of underdeveloped housing company practices. For example, in some cases the owner of a single apartment can stall improvement projects in the entire building. Many such problems could be solved by simply applying management practices that are in general use in housing companies in other countries.

Presently consumers are reported to have problems obtaining information about energy efficiency, technology and finding the right products for their particular circumstances. This could be facilitated perhaps by devising products and creating business models whereby improvements could be purchased as complete packages on a turnkey basis. The role of government could be in providing neutral information and recommendations.

Also, gathering the information on the different products available in the market place to one place, e.g. website, where consumers could evaluate and compare them, would help with the arduous process of going through the myriad products usually provided by small and medium-sized companies.

Problems with financing also appear to be common. Some countries have designated credit institutions providing financing for energy efficiency investments. This approach could merit further study by other countries. Some way of providing credit for these investments on preferential terms seems justified based on the returns they generate in the form of savings in energy costs.

It is noteworthy, that not many mentioned any specific training efforts to improve the skills of the people implementing the energy efficiency improvements, even though the lack of skills was a commonly cited barrier to further improvements.

5 Conclusions

Energy consumption in residential buildings varies greatly depending on the type of building, construction year and many country-specific factors, such as climate. Highest average heating energy consumption was reported in old Latvian houses, 280 kWh/m^2/a, whereas new Bulgarian apartment buildings consume on average 66 kWh/m^2/a. In total, the existing stock of single-family houses in the ten countries consumes 877 000 GWh of energy for space heating annually and apartment buildings 474 000 GWh. More details are provided in section 3.1.

The countries have very different energy savings potentials depending on the size and condition of the housing stock. In absolute terms, greatest savings potentials are in Germany and the United Kingdom mostly due to the sheer size of the housing stock in the said countries. Relative to present energy consumption, greatest savings potentials were identified in Latvia, Bulgaria and Portugal.

In total, 88 TWh/a could be saved in single family houses by the year 2020 and 58 TWh/a in apartment buildings, totalling 146 TWh/a. By 2030 similar figures are 169 TWh/a for houses and 110 TWh/a for apartments, totalling 279 TWh/a for all dwellings. In relative terms the potential represents around 10 % by 2020 and 20 % by 2030 of present heating energy consumption.

All of the countries report the status of the implementation of EPBD as complete or nearly complete. The Czech government expects to finish its legislative work in 2009 or 2010. Others have completed the implementation of EPBD.

According to the reports obtained from the participating countries, a very common problem is that the improvements in energy efficiency are hindered by a lack of effect on property prices. Possible reasons for this were numerous: there might be price controls or buyers could simply be unaware of or indifferent to the energy consumption of the buildings. Another problem cited in all of the reports was the low priority for energy efficiency improvements among the consumers.

Other commonly cited barriers included

- Lack of information on energy efficiency, especially neutral, unbiased information,
- Insufficient or lax regulation and a lack of supervision and reinforcement,
- Lack of coordination and information flow between actors in the real estate market,
- Low awareness about labelling, technology etc. and
- Poor training and skills of the people who implement energy efficiency measures.

The most commonly reported public policy measures in use were ones related to information dissemination and partial public funding of energy efficiency retrofits. Regulations, ecological taxation, subsidies for renewables and R & D activities were also commonly cited.

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Netherlands	Casper Tigchelaar (ECN)	Marjolein de Best-Waldhober (ECN)	Casper Tigchelaar (ECN)
Portugal	Paula Fonseca (ISR-UC)	Paula Fonseca (ISR-UC)	Paula Fonseca (ISR-UC)
United Kingdom	Afi Adjei (BRE)	Afi Adjei (BRE)	Afi Adjei (BRE)

7 References

1. Short, W., Packey, D., Holt, T. (1995): *A Manual for the Economic Evaluation of Energy Efficiency and Renewable Energy Technologies*, National Renewable Energy Laboratory, Colorado, USA, NREL/TP-462-5173. Available at http://www.nrel.gov/docs/legosti/old/5173.pdf
2. European Commission (2006): *Action Plan for Energy Efficiency: Realising the Potential*. COM(2006)545 final. Brussels. Available at http://ec.europa.eu/energy/action_plan_energy_efficiency/doc/com_2006_0545_en.pdf
3. World Business Council for Sustainable Development (2009): *Transforming the Market: Energy Efficiency in Buildings*. Geneva, Switzerland. Available at http://62.50.73.69/transformingthemarket.pdf
4. Golove, W. & Eto, J. (1996): *Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency*. University of California Berkeley, California, USA. Available at http://eetd.lbl.gov/ea/EMS/reports/38059.pdf

Appendix I. Barriers Reported by the Member States

(in a separate file)

Appendix II. Policy Measures Reported by the Member States

(in a separate file)

Appendix III. Inventory of Housing Stock in the Member States

(in a separate file)