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Energy savings potential in buildings and overcoming market barriers in member states of the European Union

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ABSTRACT

In this study the barriers to energy savings and the policy measures set up to overcome these barriers were mapped by interviewing stakeholders in ten European Union member states (MS). In addition, an estimate of energy savings potential was calculated. It seems that in most countries cost-effective energy savings of about 10% can be achieved by 2020 and 20% by 2030. A total annual energy saving of approx. 150 TWh by 2020 and approx. 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. Barriers and policies to overcome them were also studied. This was based on a literature review, stakeholder interviews and in-depth homeowner interviews in ten MS. A commonly cited problem was that people are not keen to improve energy efficiency of their homes as it does not proportionately increase the value of the property. Another widespread problem was that energy prices do not include all the negative external costs that the use of energy causes, such as pollution. The most commonly reported public policy measures in use related to information dissemination and subsidies for energy efficiency retrofits.

1. Introduction

Improving energy efficiency is regarded by the European Commission (EC) as a key element in the Community energy policy. It is described by the Commission as the most effective way to improve security of energy supply, reduce carbon emissions, increase competitiveness and stimulate the development of markets for new energy-efficient technologies. EC reports that the household sector has been estimated to represent 27% of the energy savings potential by the year 2020 [1].

Article 11 of the newest version of the Energy Performance of Buildings Directive (EPBD) stipulates that residential buildings must have an Energy Performance Certificate (EPC) when they are sold, rented out or constructed. The EPC includes a label rating of the energy efficiency of the dwelling and recommendations of cost-effective energy saving measures. The idea of the certificate is an assumption that decisions made at home are based on information available to the household about cost-effective energy saving measures (see preamble to the directive [2]).

The success of the EPC depends to a large extent on the conditions in member states. In the international cooperation project IDEAL EPBD, both technical and institutional country specific characteristics were investigated. The aim was to estimate energy savings achievable in the housing stock in selected member states (MS) in the European Union, and to identify obstacles that hinder active implementation of energy enhancement measures. The energy-savings potential was obtained by calculation. The obstacles for large-scale energy improvements were searched by studying dedicated policies in place in the MS, and by interviewing stakeholders and surveying homeowners.

The aim of this study is to analyse the effect of market barriers on energy conservation, and to compare the results from various countries and various policy measures, to learn the most effective ways to overcome market barriers and to change consumer behaviour. These insights can be used later to design country-specific policy recommendations.

2. Methods

2.1. Housing stock inventory

The retrievable statistical data on building stock is very non-uniform in different countries in the European Union and it remains very challenging to reliably assess the energy consumption on a large scale. Balaras et al. [3] used the energy consumption data collected during energy audits in 193 buildings in 5 countries as a

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base for their analysis. More recently, a typology of buildings representative for the building stock was employed by Nemry et al. [4] to study the cost of environmental impact reductions in European residential buildings.

In addition to energy consumption itself our study also had a broader context, including barriers to and policies promoting energy efficiency. Nevertheless, the starting point for our study was to estimate the size, composition and energy consumption of the housing stock in the following countries: Bulgaria, the Czech Republic, Denmark, Finland, Germany, Latvia, the Netherlands, Portugal and the United Kingdom. Moreover, Belgium was included in the study of market barriers and policy instruments.

The inventory of housing stock was compiled from data collected by the IDEAL EPBD research teams in each participating country. The method chosen here is similar to Nemry et al. in the criteria for defining building typologies [4]. Research partners in each country provided their respective stock data including, but not limited to, the following information.

- Size of housing stock categorised by two general types of buildings: single-family houses and apartment buildings. Dwellings were also grouped by age, age bands varied in most countries, depending on the categories used in the data provided.
- Past and expected rates of renovations aimed at improving energy efficiency of homes.
- Types and costs of different energy efficiency measures, etc.

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

2.2. Calculating the baseline and savings potential

The data on the housing stock collected from each country provided a baseline for the savings potential for existing dwellings. The calculations were carried out for each country separately, based on national statistics, in the following order. Belgium was not included in this part of the study. The data for the calculations was collected by the project partners in the various countries and supplemented with expert estimates where figures were not available. The primary sources for each country were [5,6] for Bulgaria, [7–9] for the Czech Republic, [10,11] for Denmark, [12–14] for Finland, [15–18] for Germany, [19,20] for Latvia, [21–24] for the Netherlands, [25–27] for United Kingdom and [28–30] for Portugal. The amount of input data is too large to be represented here in detail, but some average values representative of the data are shown in Table 1.

First, the data on the size of each age group of buildings and their respective heating energy consumption was used to calculate the present energy consumption to be used as a baseline. Thus, a given age group of buildings in a given country consumes the amount $Q_{heating}$ of energy for heating annually when

$$Q_{heating} = A \times Q_{specific}, \tag{1}$$

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

Then, 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 annualised for ten years with an interest rate of 10%, with the equation

$$R = \frac{P_{total}}{1 - (1/((1+i)^m))/i} \tag{2}$$

Table 1
Summary of key data used in the calculations.

	Area[a] (×1000 m^2)	Renovations[b] (%)	Min price[c] (€/m^2)	Max price[d] (€/m^2)	Heat before[e] (kWh/m^2)	Heat after[f] (kWh/m^2)
Bulgaria						
Houses	128,485	3.2	10	90	143	25
Apartments	154,137	3.0	10	90	96	56
Czech Republic						
Houses	155,583	1.0	13	200	190	68
Apartments	134,394	0.8	13	160	194	134
Denmark						
Houses	173,143	1.8	34	43	139	80
Apartments	101,121	2.2	31	38	135	61
Germany						
Houses	1,354,428	1.4	7	57	254	137
Apartments	2,020,743	2.0	4	57	185	74
Finland						
Houses	148,000	3.1	4	25	154	118
Apartments	120,500	3.1	7	20	154	141
Latvia						
Houses	22,237	4.9	40	130	273	202
Apartments	37,863	4.7	70	133	217	145
The Netherlands						
Houses	588,401	1.7	34	43	125	54
Apartments	150,299	2.2	31	38	103	52
Portugal						
Houses	227,480	1.1	11	36	114	45
Apartments	256,934	1.1	11	36	117	46
UK						
Houses	1,857,497	1.9	3	5	216	119
Apartments	328,111	2.2	3	7	172	53

[a] Built floor area (×1000 m^2).
[b] Weighted average of annual renovation rate (%).
[c] Lowest average cost of an energy efficiency improvement studied (€/m^2).
[d] Highest average cost of an energy efficiency improvement studied (€/m^2).
[e] Weighted average of annual heating energy consumption before improvements (kWh/m^2).
[f] Weighted average of annual heating energy consumption after all cost-effective improvements are implemented (kWh/m^2).