ENPER-EXIST

Applying the EPBD to improve the Energy Performance Requirements to Existing Buildings – ENPER-EXIST

WP4: **Roadmap for energy efficiency measures/policies in the existing building sector**

FINAL REPORT
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Editors and co-authors
Loncour Xavier
Wouters Peter
Vandaele Luk
Belgian Building Research Institute

Intelligent Energy Europe

Participants in ENPER-EXIST and co-authors:

France (CO): Centre Scientifique et Technique du Bâtiment (CSTB)
Jean-Christophe Visier
Rofaïda Lahrech
Ahmad Husaunndee
www.cstb.fr

Belgium: Belgian Building Research Institute (BBRI)
Peter Wouters
Xavier Loncour
Luk Vandaele
Dirk Van Orshoven
www.bbri.be

Denmark: Statens Byggeforskningsinstitut (SBi)
Kirsten Engelund Thomsen
Søren Aggerholm
www.sbi.dk

Germany: Fraunhofer Institute for Building Physics (FhG-IBP)
Hans Erhorn
Heike Erhorn-Kluttig
www.ibp.fhg.de

Greece: National and Kapodistrian University of Athens (NKUA)
Mat Santamouris
grbes.phys.uoa.gr/

The Netherlands: Netherlands Organisation for Applied Scientific Research (TNO)
Dick van Dijk
Marleen Spiekman
www.tno.nl

The Netherlands: EBM-consult
Bart Poel
Gerelle van Cruchten
www.ebm-consult.nl

United Kingdom: Energy for Sustainable Development Ltd. (ESD)
Robert Cohen
www.esd.co.uk

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ENPER-EXIST project information

The ENPER-EXIST project was initiated and is coordinated by the Centre Scientifique et Technique du Bâtiment (CSTB) within the framework of the Intelligent Energy Europe (EIE) programme within SAVE of the European Commission, DG TREN. It involves partners from seven countries on the topic of energy performance standardization and regulation. Contract EIE/04/096/S07.38645. Duration: 01/01/2005 - 30/07/2007.

The Energy Performance of Buildings Directive (EPBD) sets a series of requirements specifically dedicated to existing buildings, but the member states are facing difficulties in implementing these requirements. The main goal of the ENPER-EXIST project is to support the Energy performance of buildings directive (EPBD) take-off with regard to existing buildings.

ENPER-EXIST has four main objectives:

1. To defragment technical work performed on existing buildings. Indeed actions already launched in CEN to apply the EPBD are defragmented, but mainly focus is on new buildings. On the other hand different projects regarding the certification procedures are going on at the European level, but are not coordinated.
2. To defragment work on legal, economical and organisational problems such as the analysis of certification on the market, the human capital and the national administrations.
3. To achieve a better knowledge of the European building stock.
4. To define a roadmap for future actions regarding existing buildings.

ENPER-EXIST uses an intensive networking of existing national and international projects to reinforce efforts to solve these issues. It works in close coordination with the Concerted Action set up by Member States to support the application of EPBD. The work program is split in 4 technical work packages in addition to dissemination and management activities.

WP1: Tools application
WP1 analyses how existing buildings are taken into account in technical tools such as CEN standards, national calculation procedures. Recommendations on how to improve the consideration of existing building are be defined.

WP2: Legal economical and organisational impact
WP2 analyses the impact of the certification procedures and regulations of existing buildings on the market, on the human capital and on the national administration. Surveys are carried out in the different member states and recommendations are drawn up.

WP3: Building stock knowledge
WP3 analyses the level of information available in each country regarding the existing building stock. A procedure enabling to refine this information and ways to use the certification procedure as a tool to collect data regarding this stock is developed.

WP4: Roadmap
An overview of possible legal measures for existing buildings is written. Indications are given about alternative strategies to improve on a wide scale the energy efficiency of existing buildings. Possibilities (including pro's and cons) to widen the scope of the EPBD in case of a future revision of the requirements of the directive are described.

A website, newsletters and workshops enable a strong interaction between ENPER-EXIST and different interest groups and a wide dissemination of ENPER-EXIST results. The workshops are organised with the different actors involved in the application of the EPBD. More information on the project website: www.enper-exist.com

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Executive summary

Energy efficiency is becoming a very important topic in Europe and around the world. Among the different sectors where energy savings can be realised, the European action plan for energy efficiency of the European commission [2] has identified the building sector as a top priority.

Huge cost-effective energy savings can be realised in existing buildings. The action plan for energy efficiency states a potential by 2020 of 27% to 30% according to the building type. Realising this potential will not be done by itself and a set of accompanying measures should be developed and implemented by different actors.

The report gives first an indication of the short, medium and long-term challenges regarding the energy efficiency of buildings.

Then, attention is paid to the specific characteristics of the existing building stock.

It then gives an overview of possible legal measures and other types of measure that can be implemented. The status of the existing measures allowing the improvement of the energy efficiency of buildings in 7 European countries is explained. At the same time, examples of national long-term vision about building energy efficiency are given.

This report gives also indications (including pro's and con's) about the possibilities to enlarge the scope of the Energy performance of buildings directive.

Introduction and objective of the study

This document has been written in the scope of the European project EIE2003 SAVE ENPER EXIST (www.enper-exist.com). The ENPER EXIST project aims to support the take-off of the Energy Performance of Building Directive (EPBD) in the field of existing buildings.

The EPB Directive

The Directive 2002/91/EC of the European Parliament and Council on energy efficiency of buildings [1] was adopted on 16th December 2002 and entered into force on 4th January 2003. It is considered as a very important legislative component of energy efficiency activities of the European Union designed to meet the Kyoto commitment and responds to issues raised in the recent debate on the Green Paper on energy supply security.

Estimates project a cost-effective savings potential realizable by 2010 of around 22% within the building sector - if this potential was realized, around 20% of the EU Kyoto commitment could be met. Transposition of this Directive by 2006 at the latest will allow a portion of this potential to be translated into reduced energy consumption.

The Directive is foremost a measure that concerns a very large number of actors on all levels and with different impacts and different motivations: designer, housing associations, architects, providers of building appliances, installation companies, building experts, owners, tenants, essentially all energy consumers in the European Union.

It will greatly affect awareness of energy use in buildings, and is intended to lead to substantial increases in investments in energy efficiency measures within these buildings.

Energy efficiency of existing buildings

Huge energy savings can be realised in existing buildings. The action plan for energy efficiency (hereafter called 'the action plan') states : "Partly because of its large share of total consumption, the largest cost-effective savings potential lies in the residential (households) and commercial buildings sector (tertiary sector), where the full potential is now estimated to be around 27% and 30% of energy use, respectively. In residential buildings, retrofitted wall and roof insulation offer the greatest opportunities, while in commercial buildings, improved energy management systems are very important."

An even greater potential, of up to 50% of energy use is thought to exist if energy prices increase dramatically or if energy policies are given higher priority than at present.

Realising this potential will require a set of accompanying measures to be developed and implemented by different actors. This first aspect is widely addressed in this report.

A revision of the EPBD in order to enlarge its scope is also a way (already envisaged in the action plan) to speed up and increase the improvement of the energy efficiency of existing buildings. This second aspect is also addressed into this report.

Contribution of this report

Within the ENPER EXIST project a specific work package (WP4) addresses the long-term vision on energy efficiency improvement in buildings and tends to:

- give a clear overview of possible legal measures for existing buildings, including illustration with available examples and proposals in preparation (WP4.2)

- o give indications of alternative strategies for a wide scale improvement of the energy efficiency of existing buildings (WP4.3)
- o indicate possibilities to widen the scope of the EPBD in case of a future revision of the requirements of the EPBD (WP4.4)

These elements are addressed into this report.

Structure of the report

The first chapter describes the overall context of energy in buildings. Aspects as overall environmental context, energy supply, economical aspects or social dimension are addressed.

Within the building stock, existing building are presenting specificities which have to be taken into account when developing measures tenting to improve the overall energy efficiency of the building stock. These specificities are presented under the chapter 2.

In order to identify possible and effective measure to improve the energy efficiency of existing buildings, a segmentation of the building stock has been realised. Some measures can be very efficient in a specific context (e.g. environmental permit in the case of office building) but be inefficient in a different context (e.g. rented apartment building). The way the segmentation of the existing building stock has been realised and the different identified relevant cases is described under the chapter 3.

Based on the results of the previous chapter, the chapter 4 gives the overview of effective and possible measures to improve the energy efficiency of existing buildings. The distinction is made between regulatory measures and the other measures.

The chapter 5 presents the toolbox that has been developed in the context of this report. The toolbox can be considered as the entrance portal to the information enclosed in this report.

The chapter 6 presents suggestions for EPBD revision including pro's and con's of each identified possible way

Target audience of this report

The primary target audience of this report are **policy makers and persons interested in policy issues regarding energy efficiency of buildings.** The emphasis lies on the achievement of substantial medium and long-term improvements of the energy performance of the existing building stock.

1 The overall context for energy in buildings

In this chapter, the following aspects regarding energy in buildings are discussed:

- Overall environmental context
- Energy supply
- Economical aspects
- Social dimension
- Employment potential
- Indoor climate

1.1 Overall environmental context

During the past few years, increased evidence (International Panel on Climate Change (IPCC) [16]) : has become available that human activities have an impact on the climate change and that this climate change can have a substantial impact on life on the earth with potentially very high costs. The hot summers and very mild winters, the increasing occurrence of heavy storms seem to confirm the climate change.

In its Fourth Assessment Report (February 2007) the Intergovernmental Panel on Climate Change (IPCC) states:

> *The understanding of anthropogenic warming and cooling influences on climate has improved since the Third Assessment Report (TAR), leading to very high confidence[7] that the globally averaged net effect of human activities since 1750 has been one of warming,…*

The following indications of climate change effects are given:

- *Eleven of the last twelve years (1995 -2006) rank among the 12 warmest years in the instrumental record of global surface temperature9 (since 1850).*
- *The average atmospheric water vapour content has increased since at least the 1980s over land and ocean as well as in the upper troposphere. The increase is broadly consistent with the extra water vapour that warmer air can hold.*
- *Observations since 1961 show that the average temperature of the global ocean has increased to depths of at least 3000 m and that the ocean has been absorbing more than 80% of the heat added to the climate system. Such warming causes seawater to expand, contributing to sea level rise.*
- *Mountain glaciers and snow cover have declined on average in both hemispheres. Widespread decreases in glaciers and ice caps have contributed to sea level rise.*
- *…losses from the ice sheets of Greenland and Antarctica have very likely contributed to sea level rise over 1993 to 2003.*
- *Global average sea level rose at an average rate of 1.8 [1.3 to 2.3] mm per year over 1961 to 2003. The rate was faster over 1993 to 2003, about 3.1 [2.4 to 3.8] mm per year. Whether the faster rate for 1993 to 2003 reflects decadal variability or an increase in the longer-term trend is unclear. There is high confidence that the rate of observed sea level rise increased from the 19th to the 20th century. The total 20th century rise is estimated to be 0.17 [0.12 to 0.22] m.*
- *….etc…*

The environmental concerns are translated into a wide range of policy plans. These plans can be typically split up in 3 groups:

- Short term – horizon is typically 2010…2012
- Medium term – horizon is typically 2020
- Long-term – horizon is typically 2050

In the next few paragraphs, a brief overview of the short, medium and long-term challenges and examples of action plans regarding energy use of the building stock is given.

1.1.1 Short term – 2010

For the European building stock, there are 3 major short term and highly related challenges:

1. Implementing a series of measures in order to provide a substantial contribution to the achievement of the targets as specified in the Kyoto protocol;
2. Implementing the measures as specified in the Energy Performance of Buildings Directive (Directive 2002/91/EC)
3. Implementing the Directive on energy end-use efficiency and energy services (Directive 93/76/EEC)

In the framework of the **Kyoto Protocol**, there are no specific targets for the building sector alone. However, given the fact that the buildings related energy consumption is a substantial part of the total energy consumption, it is clear that improvements in the energy efficiency of buildings is important.

The decisions made when constructing new buildings can have a very large impact on the energy consumption of these buildings. Savings of 50% or more can be achieved.

> An illustration is the Dutch energy performance legislation. For new buildings, the minimum performance level has been substantially reinforced: from a reference value of 1.4 in 1995 to 0.8 in 2006 or a reduction of 43%.

Although the potential savings in new buildings is very large, this does not necessarily lead to a substantial reduction of the energy consumption of the total building stock. The main reason being the relatively low number of new buildings compared with the stock of existing buildings. This percentage can vary a lot, with at present the highest percentage of new buildings in Ireland.

In order to realise a substantial saving in the existing building stock, one has to improve the energy performance of the existing building stock. In many countries, there are a wide range of measures in place or in preparation whereby there is specific attention for the existing building stock. These measures often include financial stimuli.

> An example is the financial stimuli which exist at present in Belgium. At federal level, there is the possibility for fiscal deduction for a range of energy efficiency measures, e.g. installation of high efficiency glazing, condensing boilers, roof insulation. Up to 40% of the investment cost can be recovered through the fiscal deduction.
>
> In addition, the three regions have subsidy schemes in place. Moreover, there are also communes which have additional support schemes.
>
> It is important to identify critical target groups for which additional measures may be appropriate. An example is persons who don't have to pay taxes. It is clear that for those persons, fiscal deduction has no sense since they pay no taxes. In France fiscal deduction are replaces by a fiscal credit for those persons. In the Flemish Region, it is envisaged to increase the subsidies for people who don't pay taxes.

The **Energy Performance of Buildings Directive** (EPBD [1]) lays down requirements as regards:

(a) the general framework for a methodology of calculation of the integrated energy performance of buildings;

(b) the application of minimum requirements on the energy performance of new buildings;

(c) the application of minimum requirements on the energy performance of large existing buildings that are subject to major renovation;

(d) energy certification of buildings; and

(e) regular inspection of boilers and of air-conditioning systems in buildings and in addition an assessment of the heating installation in which the boilers are more than 15 years old.

The Member States (MS) were assumed to implement these directive not later than January 4 2006 unless they were able to proof a lack of inspectors in which case a delay until January 4 2009 can be obtained. In practice and mainly due to the high technical, organisational and legal challenges, this target date has not been met by the large majority of MS.

For the existing building stock, the impact of this directive is mainly related to the requirement of energy certification of existing buildings when sold or rented and the need for regular inspection of boilers and air conditioning. Moreover, it is also necessary to improve the energy efficiency of large buildings which undergo a major renovation.

The following observations are important:

- the EPBD does not impose any quantitative target in terms of energy efficiency. It is sufficient that MS impose requirements for new buildings (whereby the target can be the same as in the past) and no performance targets have to be imposed for existing buildings (except when major renovations of large buildings)
- the EPBD will probably substantially increase the awareness regarding the energy efficiency of existing buildings for those buildings on sale or for rent.

The **Energy Services Directive** (ESD [2]) does not specifically deal with buildings. However, it specifies overall absolute targets for the MS. In article 4, the following target is specified:

> "Member States shall adopt and aim to achieve an overall national indicative energy savings target of 9 % for the ninth year of application of this Directive, to be reached by way of energy services and other energy efficiency improvement measures. Member States shall take cost-effective, practicable and reasonable measures designed to contribute towards achieving this target."

In practice, this target if often translated as an energy saving of 1% per year. Given the importance of the building related energy consumption, it is clear that implementation of the ESD requires specific measures for the building sector.

As such, the ESD can motivate the Member States to achieve a successful implementation of the EPBD, whereby specific attention is paid to the existing building stock.

1.1.2 Medium term – 2020

There is no doubt that the achievement of the targets as agreed in the Kyoto Protocol is far from sufficient. More steps are needed.

In the Energy Efficiency **Action Plan** [4] of **January 2007**, the European Commission proposed a comprehensive package of measures to establish a new Energy Policy for Europe to combat climate change and boost the EU's energy security and competitiveness. The package of proposals sets an overall target on greenhouse gas emissions reduction of 20% by 2020 and a further reduction by 30% if an international agreement would be reached on the post-2012 framework among the developed countries. For the building sector, the target is 30% by 2020, and this through energy measures, mainly energy efficiency and renewable energy ("…improved energy performance of the EU's existing buildings …").

The Energy Efficiency **Action Plan** of the European Commission puts forward a target of 20% reduction of the total energy consumption of the European Union

With respect to buildings, the Action Plan specifies the following:

> *The Commission will propose expanding the scope of the Energy Performance of Buildings Directive substantially in 2009, after its complete implementation. It will also propose EU minimum performance requirements for new and renovated buildings (kWh/m²). For new buildings, the Commission will also by the end of 2008 develop a strategy for very low energy or passive houses in dialogue with Member States and key stakeholders towards more wide-spread deployment of these houses by 2015. The Commission will set a good example by leading the way, as far as its own buildings are concerned.*
>
> *The Energy Performance of Buildings Directive (2002/91/EC), to be transposed by Member States by January 2006, can play a key role in realising the savings potential in the buildings sector, which is estimated at 28%, and which in turn can reduce total EU final energy consumption by around 11%. However, to reap the full potential in the buildings sector, the Commission will propose expanding the scope of the Directive to include the large stock of smaller buildings, including by lowering significantly the current threshold from 1000 m² for minimum performance requirements for major renovations to include a majority of existing buildings. In 2009, it will also propose EU minimum performance requirements for new and renovated buildings (kWh/m²) and for components, such as windows. It will take the necessary steps, in collaboration with the building sector, to develop a deployment strategy for very low energy or passive houses, with a view to moving towards this type of houses as a standard in new construction in the medium term, as the appropriate technologies become commercially available.*

In the Action plan, a series of building related measures are proposed:

- With respect to the Implementation and amendment of the EPBD :
  - propose an expanded role for the public sector to demonstrate new technologies and methods (2009)
  - propose lowering significantly the threshold for minimum performance requirements for major renovations (2009)
  - propose minimum performance requirements (kWh/m²) for new and renovated buildings and some components with a target for new buildings to approach the level of passive houses from 2015 (2009)
  - consider proposing binding requirements to install passive heating and cooling technologies (by the end of 2008)

- propose measures for Member States to provide financing for highly cost-effective investments (2009)

- With respect to the implementation of the Construction Products Directive (89/106/EEC)
  - introduce energy efficiency aspects in construction product standards whenever relevant (2008)

A major issue of concern is also the **increased use of air conditioning in buildings**. This causes major problems in terms of peak power control and several southern European countries were confronted with peak power problems during recent summers. It is very important to limit the use of air conditioning systems in buildings.

Many countries have action plans for existing buildings with a horizon of either 2020 or 2030. Many existing buildings have a very large energy savings potential. An example of such action plan is in preparation in the Flemish Region, with the target to have in 2020 a minimum performance level for all buildings corresponding with insulated roofs, no longer single glazing and the availability of high efficiency heating systems (see §4.4.1).

1.1.3 Long-term – 2050

On the long-term, a very substantial reduction in GHG emissions at world level has to be realised. Thereto, a scale of measures is needed of a completely different order of magnitude than at present implemented. This clearly requires an international – world-wide collaboration. The example of the French 'factor 4' strategy gives an indication of the kind of measures which might be necessary.

Example: the French context and approach

- A very ambitious strategy called 'Factor 4' has been adopted, with the target to reduce the GHG by a 'factor of 4' between 2005 and 2050, corresponding with a 3% reduction per year over 45 years on all economic sectors.
- This official target has already introduced in the National Strategy for a Sustainable Development (June 2003), the Climate Change Programme (July 2004) and the Programme Law for Energy Policy Orientations (July 2005)
- The energy consumption of the building sector represents 43 % of the total national consumption of which 2/3 in dwellings (30 million units) and 1/3 in commercial buildings (860 heated Mm²).
- Around 3 billion m² of the building stock has to be retrofitted by 2050, whereby the following targets in energy reduction are considered :
  - reasonable target for existing buildings : on average Factor 3 to 4
  - possible target for new buildings : Factor 7 to 8
  - necessity of a large number of zero energy or "positive energy" buildings to fill the gap for reaching the 'factor 4' for the building sector.
- For the whole building sector is the goal by 2050 to :
  - reduce fossil fuel consumption from 70 Mtoe (1,1 toe/person. year) to 17,5 Mtoe
  - reduce emissions of GHG from 120 MtCO2eq (0,5 tCeq/person. year) to 30 MtCO2eq

- It is absolute necessary to enhance the global energy performance of the existing building stock. The built pre-mandatory stock could represent in 2050 between 60 to 75 % of the total building stock, whereby the actual retrofit rate is clearly insufficient to reach the Factor 4 goal, i.e. :
  - 100 % buildings has to be **totally** retrofitted but now only 11 % **partly** retrofitted each year
  - A complete retrofitting costs between 200 and 400 €/m² whereas the present retrofitting costs is typically only 25 €/m².
- In order to achieve the above targets, mandatory retrofitting for all buildings in the future might be necessary.

1.2 Energy supply

In addition to the environmental concerns related to energy use, there are also increased concerns about the guarantee of energy supply. There are different issues:

- **The physical availability of the required energy**. There are still large uncertainties about the remaining stocks of oil and gas, but it is not evident to assume that there will be sufficient availability of oil and gas in 2100 if the present pattern of energy consumption is continued.
- **The access to the available energy.** Even when physically available, there might be problems of guaranteed supply. A large part of the energy exporting countries are in political terms not the most reliable partners in terms of energy supply, as shown during recent history : the middle east, Russia, …
- **Peak power control**: as already stated, it is not evident to guarantee the required peak power of electricity. Since the construction of new power plants (in particular nuclear power plants) is in many countries from a political point a very difficult issue, it is important to take pro-active measures.

1.3 Economics

The energy price is a major driver for the interest in energy efficiency issues. During the last 2 years, there has been a sharp increase in the prices of oil. What will be the evolution of the energy prices? It is not the aim of this report to make an in depth analysis, just two observations:

- Forecasts of the evolution of the energy price often appear to be poorly correlated with the real evolutions. See Figure 1.
- The available production capacity of oil is today very close to the energy needs. This in combination with the fact that the cost of new oil exploitations is often substantially higher than of existing oil exploitations and the strong increase in demand in countries as China and India probably justifies assuming that a substantial reduction of the present price levels is not evident. A strong increase can not be excluded.

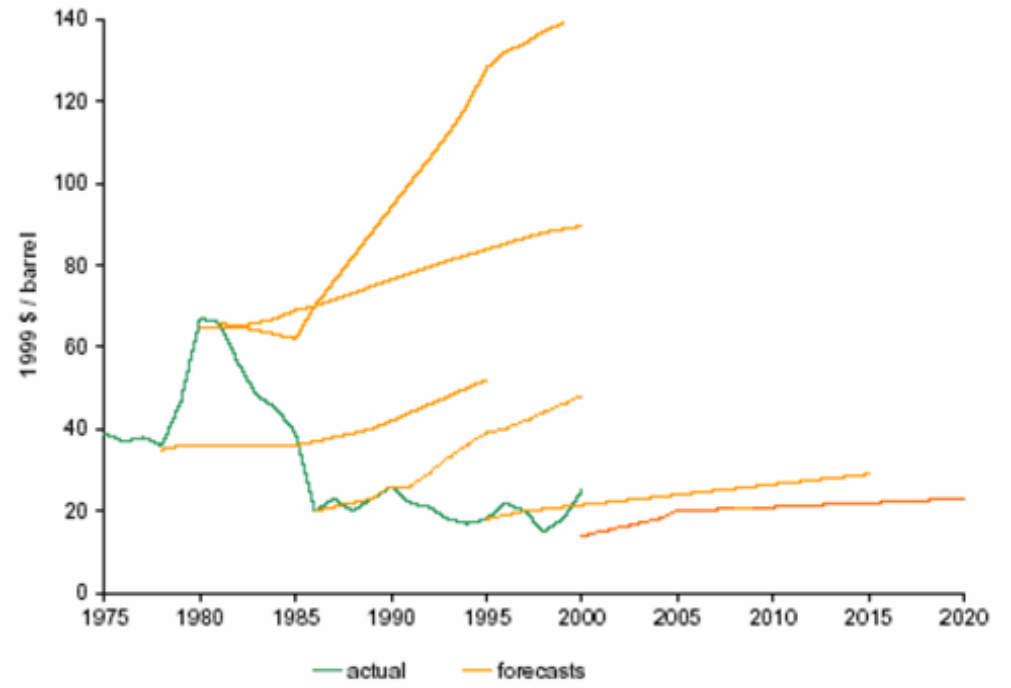


Figure 1 : A prediction of the evolution of energy prices is a highly risky business

Investments in energy efficiency improvements in buildings have overall a very good cost-benefit relation. In a study by Vattenfall [17], a very wide range of possible energy efficiency investments has been evaluated. As shown in Figure 2, many measures in the building sector are among the most cost efficient ones.

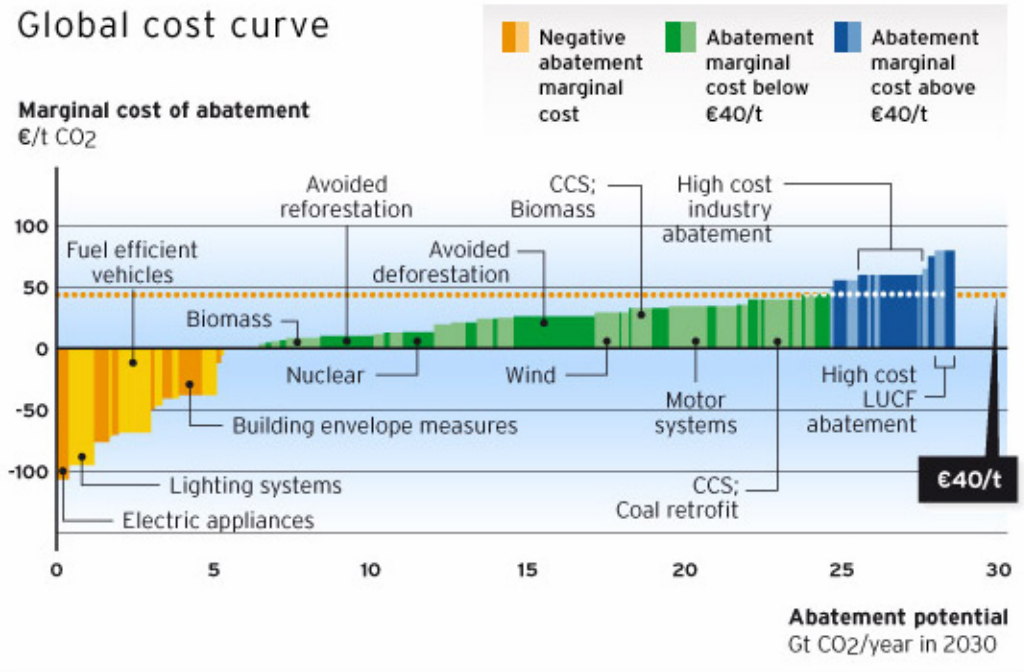


Figure 2 : Global cost curve – assessment of the marginal cost of abatement of CO2 emission of several measures [17]

1.4 Social dimension

For most citizens, the issue of energy efficiency is seen as way to limit the total budget for energy use in their buildings, cars, … However, there are also an increased number of households which are confronted with '**fuel poverty**', i.e. where a household cannot afford to keep warm - damages the health of those living in cold homes and affects their quality of life. For these household, efforts devoted to energy efficiency result in more acceptable living conditions. It is not evident to estimate the number of people confronted with fuel poverty. Figure 3, data are given for the UK.

It is clear that the majority of these households live in older buildings with often very poor thermal insulation properties and inefficient heating systems. In many countries, such problems are too often dealt with by financial subsidy of energy costs (eg winter fuel payments in UK) rather than by subsidised energy efficiency upgrades. Moreover, the high energy prices during recent years have clearly increased the number of households confronted with fuel poverty. Nevertheless, fuel poverty issues should not be allowed to emasculate energy policies which require consumers to be motivated by financial benefits. Rather, the scope for reverse pricing tariffs must be considered whereby every citizen receives a quota of reasonably priced energy but the unit price then escalates on any consumption in excess of this quota.

Table 1: Number of households estimated to be in fuel poverty in England (millions)

	Income including Housing Benefit and ISMI	Income excluding Housing Benefit and ISMI
1998 (1)	3.3	4.5
1999 (2)	3.1	4.2
2000 (2)	2.8	3.9

(1) 1998 figures are based on the 1998 Energy Follow Up Survey (EFUS) to the English House Condition Survey.
(2) 2000 and 1999 figures are broad estimates taking account of changes in fuel prices and incomes and using the 1998 EFUS results as the baseline.

Figure 3: data on fuel poverty in the UK for the period 1998-2000

1.5 Employment potential

The issue of employment is discussed in the Green paper [3], i.e. "*The Ecofys study estimates that the net job effects of the existing and a possible new directive on buildings are important. With cost-effective gains conservatively estimated at more than 70 Mtoe, this sector alone could create at least **250 000 full time jobs**. The gains in employment are for highly qualified personnel and for the building profession in general. The employment is mostly created at local level, in places where the changes to buildings have to be made.*"

According the German Council for Sustainable Development, more than 2 000 full-time jobs could be created for each Mtoe that will be saved as a result of measures taken to improve energy efficiency as compared to investing in energy production.

The improvement of the energy efficiency of the existing building stock represents a very high potential.

1.6 Indoor climate

Today, the indoor climate conditions are in many European buildings not optimal, e.g. poor thermal comfort conditions (in particular overheating problems in summer), bad indoor air quality, poor lighting conditions, acoustical problems, … The energetic retrofitting of existing buildings can, if well done, result in a substantial improvement of the indoor climate conditions. Several studies (ref. Seppanen, Hansen, …) have shown that there is a link between indoor climate and productivity whereby the increased productivity may result in larger economic savings than the savings due to a lower energy consumption.

2 Specificities of existing buildings

This paragraph discusses some specific features of the existing building stock which may represent additional barriers to implementing energy efficiency measures, when compared to the market of new buildings.

2.1 Heterogeneity of existing building stock

The existing building stock is much more diverse and complex than the new buildings in terms of the decision process regarding energy efficiency measures.

The following specific difficulties can be stated:

- Knowledge of building characteristics

  It is often far from evident to know the energy characteristics of existing buildings. This is in particular the case for older individual dwellings. Energy certification, as foreseen in the context of the EPBD, will contribute to a better knowledge of the existing buildings but major uncertainties will remain in many cases. This latter is to a certain extent country depending. As an example, the Belgian dwelling stock is much more heterogeneous than the dwelling stock of the Netherlands. In most Belgian villages, nearly each dwelling has been an individual project whereby ground plan, material use … is different from neighbouring dwellings. Such situation clearly increases the challenge for a correct characterisation of the dwellings[1] and may also lead to higher costs (especially for the expert advice) for renovation.

- Boundary conditions for owners and tenants

  There are major differences between the boundary conditions for the various actors in the existing building stock. It ranges from owners who intend to implement major renovations of their dwelling to property investors who rent apartments. In the renting market, owners are often not motivated to invest in energy efficiency, whereas tenants often not have the financial means and/or the time horizon to invest in energy efficiency measures.

- Willingness to invest in energy efficiency

  There often is a lack of motivation to invest in energy efficiency measures and this for a wide range of reasons, e.g. lack of time, lack of technical correct information, lack of economic information…

- Urban rules considerations

  Urban rules often represent a barrier for implementing certain energy efficiency measures, e.g. external insulation, installation of solar collectors …

- Practical difficulties to implement certain measures

  In particular for thermal insulation measures, there often are serious practical difficulties for implementing energy efficiency measures, e.g. :

[1] NB Most countries are introducing Energy Performance Certificates (EPCs) as legal documents which will define the energy characteristics of a dwelling when it is sold or let. Care must be exercised where inference procedures are embodied in EPC methodologies, for example inferring insulation levels not from observation but from the level required by the Building Regulations in force at the date of original construction. All too often, weak building control mechanisms mean that buildings were not built in accordance with the regulations that were in force at the time of construction.

- Insulation of facades: for masonry walls, external insulation is often the only good solution. However, in case of brickwork facades it represents a major esthetical change and moreover it is expensive.
- Floor insulation: often not easy or possible unless there is an accessible crawl space available.
- Inclined roof insulation: not straightforward if spaces below roof are already in use.

Such difficulties can be overcome, but only when the motivation is higher than it is at present.

2.2 Financial issues

The existing building stock is often confronted with specific financial aspects:

- Higher costs

  Investments in energy efficiency are nearly always more expensive in existing buildings if compared to similar measures in new buildings, e.g. insulation of roofs, insulation of walls, installation of high efficiency glazing in existing window,….

  If such measures are done because of other reasons (e.g. need to replace the roof covering of flat roofs), the cost related to the energy efficiency improvement is substantially reduced (only the extra cost due to the insulation).

- Investor doesn't benefit from the savings

  In most countries, owners of buildings who improve the energy efficiency of buildings for rent can't charge a part of the investment costs to the tenants although those tenants benefit (lower energy bill, increased comfort).

2.3 Governmental context: how to impose or stimulate energy efficiency investments?

Compared to existing buildings, in technical terms and in legal terms it is relatively easy to impose minimum energy performance targets for new buildings:

- Governments or local authorities typically have to approve the construction of new buildings and they can impose minimum requirements before delivering a building permit,
- The building and system characteristics are relatively well known (limited uncertainties),

For existing buildings, there is a wide range of cases:

- Complete reconstruction. In this case the same possibilities exist as for the new built.
- Major renovations, which require approval by local authorities. In such case, it remains relatively easy to impose requirements on the renovated parts.
- Smaller renovations, which don't require approval by local authorities. In such case, the major instrument is sensitization, financial or tax incentives, …
- Buildings where no renovations are planned. This clearly is the most difficult part of the building stock.

Currently Denmark is the only known example of a country that has regulations for the mandatory implementation of recommendations that are included in the energy certificates. This is for public buildings and covers all measures with a payback time of less than 5 years. The authors are not aware of other countries which enforce owners to improve the energy efficiency of their buildings when there is no intention of carrying out renovations. However, it cannot be assumed that this situation will remain unchanged. In the automotive industry, several countries have already imposed mandatory inspections with a minimum

environmental performance level. Cars not meeting these requirements are taken off the road.

2.4 Technical issues

The existing building stock presents specific technical challenges:

- In many cases it is not evident to obtain sufficient information about the status of the building and its installation.
- It often is not possible to improve the buildings and the performance of installations within them. Examples include façade insulation, improvement of building airtightness, installation of ventilation systems and the integration of renewable energy systems, etc.
- This is especially the case in high-rise buildings and in urban areas. Though innovative approaches might provide new opportunities. A few examples include:
  - When retrofitting apartments it often involves a whole range of measures, e.g. heating systems, ventilation systems, new kitchens including cooker hoods. There are systems on the market which integrate all of these functions and which are compact and easy to install in one piece.
  - Innovative concepts for renovation are being developed (see Figure 4) within the framework of IEA Annex 50 (Prefabricated Systems for Low Energy Renovation of Residential Buildings).
  - Within the framework of the French 'Fondation Bâtiment', interesting studies are being carried out in which new concepts for advanced single family house retrofitting is implemented. The major stakeholders are brought together into three different projects, dealing simultaneously with the development of innovative components, the organisation of global home retrofit options, as well as marketing.

Figure 4 : Use of prefabrication for high efficiency retrofitting (IEA ECBCS annex 50) [14]

2.5 National differences in boundary conditions

The cultural, economic and climatic differences are important boundary conditions for strategies regarding new buildings. Yet these boundary conditions are even more important in the renovation market.

Therefore, respect should be given to the principle of subsidiarity at European level, focusing on major political objectives, at both national and local levels, which are responsible for the actual implementation. A very good understanding of the market conditions is essential for successful implementation.

3 Segmentation of the building stock as a tool to help identify measures for improving energy efficiency of buildings

3.1 Introduction

One of the main options in Europe for reducing energy consumption is by reducing the energy consumed in buildings. Several initiatives have been taken under the EPBD [1] at a European level in order to realize this objective, they include the directive concerning the end-use efficiency and energy services [2], the green paper on energy efficiency [3] and the action plan on energy efficiency [4].

Apart from the initiative coming at European level, member states are also taking measures for reducing energy consumption. Incentives as well as regulatory measures are being taken.

In principle, energy savings could be realized in nearly every building, although some specific situations are more relevant than others. These represent either high potential energy savings, or a limited number of decision-makers being involved that therefore make it easier to implement the measures. Some building markets are more difficult to address because of the lack of motivation of those concerned actors. The most relevant building markets to be addressed in terms of priority, can be country specific, because of the peculiarities encountered in that country's building stock.

In order to identify the most interesting situations, a segmentation of the building stock is proposed in this chapter. This segmentation is arranged according to the following criteria:

1. The building type
2. Specific building situation – Type of works/transaction realized
3. The actors and their motivations

3.2 The building type

The way to encourage energy savings in buildings can depend on the building destination. This fact is strongly related to those involved actors and their motivation (see point 3.4). The following building types are identified (list extracted from the EPBD [1][2]:

- Residential buildings
  - Single-family houses
  - Apartments
- Non-residential buildings
  - Offices
  - Education buildings
  - Hospitals,
  - Hotel and restaurants
  - Sport facilities
  - Wholesale and retail trade service buildings

[2] A more refined segmentation can be implemented by introducing other specific types of buildings including care-homes, jails, ... Even if relevant, this has not been considered within the scope of this report.

- Other types of energy consuming buildings

3.3 Specific building situation – Type of works/transaction realized

Within the life of a building, certain situations come along where the chance to implement energy saving measures is high. When a building is newly built or sold on, for instance, there's an opportunity to influence the decision-makers to improve the building and thereby reduce the energy consumption; this being a more likely situation than where the occupant remains in the building and would clearly not be motivated to carry out large-scale activities related to saving energy. The following situations could also be considered:

- New construction
- Existing building undergoing renovation works
  - Light renovation. The renovation works are dedicated to bringing the building up to standard e.g. in the case of a change of tenant. These renovation works do not often involve the central heating system, but may apply to individual heating systems. They may include replacing the wall boiler, descaling the heating system or the DHW network; replacing the heaters with direct electric heating systems. No important intervention is carried out on the building shell.

  - Major renovation. Major renovation deals with important renovation works of the building and especially on the building shell (e.g. a change of façade on an office building, or the insulation of exterior facades). Various definitions of this term exist and may vary from country to country. In most countries major renovations are subject to legal requirements as imposed by the EPBD article 6. The EPBD indicates the following about major renovation work:

    " Major renovations are cases such as those where the total cost of the renovation related to the building shell and/or energy installations such as heating, hot water supply, air-conditioning, ventilation and lighting is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated, or those where more than 25 % of the building shell undergoes renovation."

- Building being sold
- Building being rented
- Other situations – no renovation work or occupant movement (the occupant remains in the building without specific renovation work). Apart from the requirements for public buildings, this category of building is not covered by the EPBD.

The last situation represents a very important share of the total building stock. This situation concerns buildings where no change to those affected occurs, and where no specific action is taken. A building owner can live for many years in his building without making any changes to the energy performance of the building. In general, no legal requirements apply to this typical situation regarding energy efficiency in this kind building.

For specific building types such as offices, the renewal of the environmental permit (if existing) could also be a good opportunity to impose minimum energy requirements on existing buildings.

Since the ENPER EXIST project focuses on existing buildings, the situation regarding new construction will not be considered in this report.

3.4 Those affected and their motivation regarding energy savings

3.4.1 Introduction

Some of those affected (actors) may have an impact (conscious or not) on the energy efficiency of a building and in particular on the improvements to energy efficiency. The realization of energy savings can sometimes be the main aim, or just a positive side effect of the measures undertaken. In some cases, the main motivation is not about the realization of energy savings, but is simply a consequence of the renovation work carried out. The way to promote measures so that they have an impact on energy savings can be much more effective by insisting on certain aspects that will increase the level of comfort, or a reduction in the heating costs. This is typical when replacing single-glazing with highly efficient double or triple glazing.

The type of actors, the property relation between them and the way energy costs are distributed, the motivations regarding the energy savings can be different. Incentives as well as barriers may exist regarding the achievement of energy savings in buildings.

The different actors and their possible motivations are presented in the next two paragraphs.

3.4.2 The actors

Several actors are involved in making the decision to undertake renovation work that has an impact on the energy efficiency of a building. A summary of those involved is given below. According to the relevant situation, some people may be either directly or indirectly involved in the specific situation of a particular building. For example the local authorities are indirectly involved in the energy savings achieved in a single-family house that is privately owned, but are directly involved with the social housing they manage themselves.

- Owner of the property (or a relevant part of a building)
    - Association of owners and representatives
- Tenant of a property (or a relevant part of a building)
    - Association of tenants and representatives,
- Property/facility manager,
- Maintenance services / operation manager,
- Building contractors including local craftsmen
- Components / material providers
- Energy labelling secretary if applicable (already in Denmark),
- National and local authorities,
- Energy service providers,
- Financial institutions,
- Information sources (consumer organisations, media, etc)
- …

3.4.3 The motivations of those involved

Depending on the type of building, the type of actor and their origins, the person affected may have a multitude of motivations that can affect the measures having a proper impact on the energy efficiency of building. The following examples can be mentioned:

- No investment in the renovation work on the building because of the following:
    - Lack of interest, lack of awareness of the advantages

        - Lack of transparency of the energy quality of the building
    - Lack of technical competence of the decision-maker
    - Financial issues
        - No (or limited) direct financial advantage for the actor (e.g. energy bill not paid by the decision-maker, not possible to increase the rent of the relevant building)
        - No (or limited) indirect financial advantage for the actor (e.g. increase of the building value)
        - No budget to carry out the renovation work
    - Limited or no added value for the building
    - Too much work / too complicated
    - Limitations related to the decision-making mechanism:
        - Not possible to obtain a common agreement for an investment where there are different decision-makers
- On the other hand, other actors can directly or indirectly be interested in making energy savings for several reasons. These reasons are more or less contrary to those stated above:
    - Financial issues
        - Reduction in the heating costs
        - Increase in the building value
        - Possibility to demand higher rent for the building
        - Benefits from subsidies
    - Easier sale of building
    - Obtaining better certification for the building
    - Obtaining a higher level of comfort in the building
    - Ecological reasons (climate change / …)
    - …

3.5 Focusing on the more difficult building market sectors

3.5.1 List of relevant case studies

The combination of the three parameters identified covers the entire building stock:

1. The building type
2. Specific building situation – type of works/transaction undertaken
3. The actors and their motivations

Taking all the possible combinations into consideration would lead to having far too many different types of situations. Therefore a set of the more important ones have been identified and analyzed. These include:

Residential buildings

1. Social housing managed by public bodies
2. Residential sector - lack of enthusiasm and invisibility of energy saving measures
3. Residential sector – owners with no financial means

4. Apartment buildings – problems of co-ownership and decision-making among apartment owners and the way in which heating costs are distributed

Non-residential buildings

5. Rented office buildings
6. Educational buildings
7. Public buildings

Each case is presented in the appendix to this report. The structure of each case is as follows:

- Identification of the actors concerned
- Description of their motivation
- Identifying measures aimed at reinforcing/creating incentives and overcoming barriers

A summary of the various measures identified is presented in the next chapter.

3.6 Presentation of the cases studies

Only a short summary of each case is presented in this report. The complete texts of the seven cases can be found in the appendix.

3.6.1 Social housing managed by public bodies

In several European countries social housing represents an important part of the total residential building sector. A small number of decision-makers may have important influence on the decisions made of whether to improve the overall energy efficiency of existing buildings. Mainly two situations occur:

- The first case involves a change of tenant. In this particular case, the opportunity arises to carry out renovation work, although it has a limited influence on energy consumption.
- The second situation involves major renovation works that are going ahead and require substantial financing.

Energy efficiency is generally not the main driving factor behind the works being carried out. Important aspects including a reduction in maintenance costs and maintaining the building in a good state to provide affordable heating, should also be taken into consideration.

The focus in this case is mainly on French and British situations (the whole text can be found in the appendix to the report).

3.6.2 Owner-occupied residential buildings: problems with a lack of enthusiasm and understanding of energy saving measures.

This specific case focuses on the typical barriers related to owner-occupied residential properties. Various barriers can be identified that relate to energy saving in existing buildings. Some barriers relate to specific building categories (e.g. social housing or apartment buildings) along with their corresponding actors (e.g. tenants, (co-)owners, housing associations, local councils, etc). Other barriers tend to be more general. Actions to overcome these barriers can also vary with the type of actors involved, as well as the building category. What holds this group back from carrying out energy saving measures,

and what actions can be implemented to stimulate them into overcoming these barriers, is also addressed in the report.

The analysis was mainly carried out from a Danish and Dutch point of view. In both countries a big part of the problem concerns the lack of interest and knowledge on the part of house owners. For most house owners, energy savings are not a big issue, which is partly due to a matter of priority, but is also due to not knowing what possibilities exist, and what can be improved. Lack of action appears to be the final and crucial barrier, keeping the Danish and the Dutch house owners from investing in energy saving measures.

The complete description is available in the Appendix to the report.

3.6.3 Residential sector – owners without the financial means

This case study examines the situation of owner-occupiers living on low incomes, or in 'fuel poverty', and who have either very limited, or indeed no available income for investing in energy efficiency improvements. They own their own property, so are responsible for making any improvements, yet are not in a position to finance them, for a variety of reasons..

This case has been established by looking at the situation in the United Kingdom. It is estimated that some four million people live in 'fuel poverty' in the UK, of whom some 60% fall into the owner occupied sector. The Government's definition of 'fuel poverty' is where an individual or a family has to pay more than 10% of their total income on fuel bills in order to maintain an adequate degree of thermal comfort.

In addition to those living in 'fuel poverty', many individuals and families exist on sufficiently low incomes that they would find it extremely difficult to raise the necessary finance to invest in all but the most basic energy efficiency improvements.

This case study highlights the barriers, motivations and some possible solutions for improving energy efficiency within this sector. The complete description is available in the appendix to the report.

3.6.4 Apartment buildings - the problems of the co-ownership and decision-making

Complete apartment buildings that are not owned by a single proprietor, but have a mixed ownership of various individual owners can pose special challenges for renovation opportunities. This is because any planned changes to the building (building shell or HVAC), must get unanimous or a majority agreement from all the owners. If the future of the building is at risk, the co-owners must agree in any case. The owners meet regularly when the proposals for changes are presented, analysed, discussed and finally voted upon. This is true for any kind of renovation work or additions being made to the building, however, the following short analysis focuses on energy efficient renovations.

This document is written from a German perspective. To widen the scope, additions were made from a Dutch perspective where the situation in the Netherlands differed from the situation in Germany.

The complete description is available in the appendix to the report.

3.6.5 Apartment buildings – importance of method used to distribute heating expenses

The divergent interests regarding energy efficiency of buildings between owner and tenant are well known. The owner may have limited interest in investing in energy saving measures, since he doesn't benefit directly from the reduced heating bills.

Rented apartment buildings are considered in this case. The motivation to improve the energy efficiency of these buildings varies according to the various actors (single owner, co-

owners, tenants, owner associations, etc). The barriers can also vary according to the different actors. This report focuses on the possible motivations and barriers with regard to the way heating expenses are shared. The situation can vary according to the type of heating system (individual or collective), and in this later case, in the way that heating costs are shared (bills based on the individual measured energy consumption or by other mechanisms).

The situation specific to Belgium has been taken as starting point. The complete description is available in the appendix to the report.

3.6.6 Office buildings

Rented office buildings are an important part of the non-residential building stock. There are two main categories of actors that can be distinguished:

- **Real estate investors** (including insurance companies and pension funds) renting out office buildings for the purpose of financial profits. This category is widespread in all European member states. The tenants define the office buildings they use as a facility necessary for their primary process. They don't need to invest in a building and are able to use their capital for investment in their primary business. Their housing needs can vary through the years, and the office space has to comply with these changing needs. For these organizations, renting an office building is a sensible choice for creating flexibility in housing. A frequency of three to five years for moving from one building to another is not uncommon. During periods of uncertain economic wellbeing, the share of real estate in an investor's portfolio usually increases. In general the share of real estate in investment portfolios is reasonably consistent.
- **Large organisations with offices in many locations** including banks, insurance companies, semi-governmental organisations, etc, which decide to outsource their real estate management to a separate business unit with the specific objective of providing cost-efficient office buildings of good quality. In general, these companies operate mainly or exclusively for the mother company by renting out the offices and thus having a more extended time-frame for real estate management of more than five years. Strictly speaking, they are also professional landlords although this is a smaller part of the office building stock than the first category.

This contribution was written from Dutch and Danish perspectives. The text can be found in the appendix to the report.

3.6.7 Educational buildings

School buildings operate during the winter, spring and autumn periods and consume high levels of energy as well as having specific indoor air quality problems. Studies of more than 1200 buildings have shown that the energy consumption can be significantly reduced when appropriate energy conservation measures are taken; while the indoor air quality problems may be improved considerably by taking very simple measures.

The contribution makes an inventory of the actors concerned, including the existing barriers regarding the improvement of the energy efficiency, as well as the possible measures to improve the situation.

This contribution has been written from Greek and German points of view.

3.6.8 Public buildings

Within this report, public buildings are interpreted as buildings owned by the public, e.g. by communities, the state, or similar. As the ownership strongly influences the type of barriers inhibiting energy-efficient retrofits, buildings with public access (often also interpreted as public buildings) are not considered here. The total number of public buildings is very high. In Germany for instance, there are about 100,000 buildings in the public sector. However, these buildings are owned by various communities, which have greater restrictions on their financial limits regarding investment in energy-efficient renovations. Furthermore, the structure of the administration might differ between countries (and even between the different communities within the same country). Renovations are usually carried out because of building defects or damage and sometimes also because the function of the building has been changed. This type of renovation work does not initially focus on energy efficiency and is usually managed by the planning department of the local community. In some community administrations there is a special department dealing with energy consumption and environmental impact. If this department (or a similar group within the planning department) gets involved in at least the design phase, then the energy efficiency will be included as a renovation by-product.

This section has been written from German and Dutch perspectives. The complete text can be found in the appendix to the report.

4 Overview of effective and possible measures for improving energy efficiency in existing buildings

4.1 Introduction

There are many measures and actions aimed at improving the energy efficiency of buildings. The initiative for taking the measures can come from the authorities, as well as from third parties. Each measure tends to create or reinforce incentives, or overcome existing barriers. As a first step, only individual measures are presented in §4.2.

A list of measures has been identified by looking at which measures already existing in the seven countries participating in the project (§4.3), and seeing which policies are under preparation or discussion in order to improve the existing situation (§4.4).

Figure 5: The seven countries participating in the ENPER EXIST project: Belgium, Denmark, France, Germany, Greece, the Netherlands, the United Kingdom

The analysis of the problems encountered in the specific building sectors (§3.5) has also provided some input for this list.

The peak level of efficiency of some of the measures will often be reached by combining several measures at the same time. It is often necessary to put together packages of measures in order to make them more efficient and obtain better results. This point is addressed at §4.5.

The measures presented are classified according to several categories. For most of the measures, a description is given as well as description of national examples. These examples are described in more detail in the appendix report. All the building types are assessed using a relevant measure, even if in practice the way in which a measure is implemented can differ according to the building type.

The ambition of this report is not to be exhaustive. The objective of the national examples is to illustrate the different measures. Other examples not stated may exist, as they are not known to the authors.

The main focus of the measures presented here is in the energy efficiency of buildings. Other important factors should also be considered when setting up policies, and include the global housing situation and social aspects including ‘fuel poverty’. These considerations are not always stated along with the descriptions of the individual measures, but should be kept in mind.

Some measures perhaps cannot be implemented, because they would prove to be unpopular, as in the case of a global energy tax.

One of the challenges to the catalogue of measures presented below is in reaching a balance between simplicity, effectiveness and having a broad field of application.

4.2 Overview of the existing measures and actions

Some of the measures described below can be classified into several of the categories already identified. The measures described below are generic measures. The application in a specific country must always take the specific situation into account. The efficiency of each measure will also depend on the national context. In some European countries (e.g. eastern part of Germany), about 60% of the dwellings are rented, and in others such as Spain, about 80% of the dwellings are owner-occupied[3]. Such differences require that the instruments are adapted and that the application of the subsidiarity principle is necessary. The measures are classified according to the following categories:

1. The regulatory measures
2. The financial levers
3. Non-governmental activities
4. Research / demonstration and development projects
5. Promotional measures / increase public awareness

1 The regulatory measures

In this paragraph possible legal measures are included as they can have a direct, or indirect impact on the energy performance of buildings. Regulations having a direct effect, as well as supporting measures are identified.

1.1 Legal requirements (technical)

The different measures or actions identified are given below:

1. Adoption of or reinforcement of requirements

   This item contains two separate aspects:

   - *Adopting requirements,*
   - *Reinforcing existing requirements. The German and Dutch examples show how the requirements have been strengthened regularly.*

   After completely transposing the EPBD in all European countries, the second aspect will become the most important.

   The way the requirements have been strengthened in the past is explained using numerical illustrations for Denmark and Germany. This point is also addressed for France, the Netherlands and the United Kingdom.

   a. At building level - overall energy performance

      This level of requirement is imposed by the EPBD. The EPBD articles 3 & 4 impose the adoption of a methodology for the calculation of the overall energy performance as well as the adoption of requirements.

      All countries already have, or are developing such national requirements.

[3] Source Eurostat

b. At building level - subset performance

In some countries, subset performance levels are imposed. Subset performance allows special attention to be paid to specific parts of the building having an important impact on the energy efficiency as an average U-value for the building shell.

Requirements at this level are already imposed in Belgium, Denmark France and Germany.

c. At the component level

Most of the countries also adopt also requirements at the component level. The example of the maximal U-values is well known. Imposing regulations at the component level allows taking very energy inefficient components out of the market including single-glazing or low performance boilers. This kind of requirement may have a direct impact on the material/component manufacturers, which may enforce change to their range of products. One of the most difficult things regarding energy saving in buildings is to convince decision-makers to carry out renovation work. This kind of requirement (in parallel with, e.g. sector agreement) must make it possible to avoid the realization of renovation work using low efficiency energy components.

All countries have requirements at this level.

d. Enlarging the field of application for the requirements

Most of the European countries have, or will adopt requirements regarding new buildings and major renovation work. The largest majority of existing buildings do not fall under any regulations within the legislation. For these buildings, an enlargement of the field of application for the legislation could occur.

With the introduction of the EPBD, an extension of the requirements regarding periodic control of heating and cooling systems must be made. This point is stated by nearly all of the countries.

2. Adaptation of energy and environmental standards

Legislation often makes reference to standards (e.g. product standards). In this way standards are written down and may influence the possibilities for member states to adopt more efficient regulations. An example can be given concerning the information included in the CE marking of products. If no reference is made to the energy efficiency of the product, then member states don't have the basis to lay down complementary regulations of those performances. Energy and environmental standards should be written in a way that allows member states to adopt efficient regulations (see also results of the WP1 of the ENPER EXIST project [9]).

The various countries don't really have direct influence over this issue. The responsibility for this aspect lies mainly with the standardization committees.

3. Visible meters in the building

The amount of energy consumed in a building cannot be directly viewed by its occupants, so that the installation of energy consumption meters in buildings could contribute greatly to raising the awareness of consumption. Similarly with visible energy certificates being imposed on public buildings; the requirement to have visible meters could reinforce this incentive.

The imposition of having to have meters in buildings already exists in Denmark and France. The UK envisages the future introduction of this measure. The promotion of making energy consumption visible is stated in the Danish action plan for renewed energy savings measures.

Belgium, Germany, Greece and the Netherlands state that although meters are not legally required, these are generally installed for billing purposes. In these situations, it is possible that only one meter is installed for several dwellings and/or buildings.

4. Regulations compliance check

   Studies have shown that the compliance with building code regulations is not always evident in some European countries [11]. Efficient compliance checking mechanisms would be one element in the whole process of ensuring an energy efficient building stock.

   Different regulation compliance checks implemented in the various countries are described in the national appendices. In the Belgian example within the Flemish region, compliance has to be proved by an independent expert after the construction is finished and is based on the state of the completed building ("as-build situation"). A comparable approach is taken in Denmark.

5. Public / governmental buildings

   a. Stricter requirements for governmental buildings

      The authorities should follow the good example given by the European Commission with the Berlaymont Building. Stricter requirements for government buildings than for the private sector would follow in this direction.

      This approach is taken in Germany. France also specifies a list of performance criteria for government buildings. In Denmark cost-effective recommendations enclosed in the energy certificate are mandatory for public buildings. Finally, the UK has set specific objectives for the reduction of energy consumption in all government properties.

   b. Integration of the energy performance of buildings in public procurement procedures

      In several countries, the initial price of the construction works is the only criteria taken into account in public procurement procedures. The integration of life-Cycle Costing techniques or a kind of cash flow analysis would lead to better investment decisions that are not only based on the initial investment costs.

      In several countries (Greece, UK), building investment and operational costs are separate budgetary items; this last point is not considered in the initial decision.

      For new school buildings in the Flemish region of Belgium, the standard maximum allowable cost can be increased to accommodate improved EPB performance.

      In France decisions can be based on the "best proposal", which make it possible to take energy criteria into account. This approach is also becoming increasingly important in Belgium, Denmark, Germany and the Netherlands.

   c. Renovating public buildings

      Measures focusing on decision-makers managing large numbers of buildings may have a substantial impact. Ambitious renovation programs of public buildings provides governmental authorities an excellent opportunity to lead the way by example..

      In general, no regulations regarding this type of renovation work are in place. However such programs (B, GR) are implemented on a voluntary basis in Belgium (school buildings), France, Germany and Greece and sometimes involve Third Party financing (see page 40).

      In Denmark, there's no systematic program in place, although regulations regarding the quality of energy performance in public buildings can be more stringent in cases of renovation. A similar situation exists in Germany.

1.2 Other supporting legislative measures

Various measures/actions identified are shown below:

1. Energy certification scheme

   Energy certification of buildings should be implemented in all the European countries. This has been stated by different member states as an important element in the overall strategy of improving of the energy efficiency of buildings through raising awareness.

   a. How certificates should be communicated / displayed

      Not only the certification system is important itself, but also the way in which the information is disseminated (e.g. via Internet etc) can have an impact on the amount of interest in certification. The way that the certificates will be made available is described in the various contributions.

      All countries state that certification must only be presented to the buyer / tenant. No initiative is stated for making the certificates public for anyone to see. In the Netherlands, housing corporations publish an Energy Index (EI, a figure that indicates the level of energy efficiency of a building and which is the basis for the energy label) when advertising houses for rent.

      Some countries state that they have a central database of certificates or that they are being developed (B, England and Wales). In Greece, no decision has been taken yet, but such databases might be available in the future. The Dutch government is considering the possibility of providing an Energy Index of buildings within a database accessible to the public; the Kadaster (land registry).

      Finally, Germany states that some cities publish energy reports for public building stocks on a voluntary basis.

   b. Make the recommendations in the energy certificates mandatory

      Energy certificates contain recommendations for improving buildings. In most countries, the certificate is seen as a source of information about a building, but without any obligations attached.

      Denmark is the only country having regulations regarding the mandatory implementation of recommendations that are included in the energy certificates. These are for public buildings and cover all measures taken that have a pay-back time of less than 5 years.

   c. Base the development of the adapted supporting tools on the knowledge of the building stock gained through the collection of energy certificates

      The development of energy certification of buildings is an opportunity to gain improved information of the existing building stock. The ENPER EXIST WP3 project states possible feedback of the improved information of the building stock, and the adoption of more suitable supporting measures [10].

      This link for the development of the new energy certification scheme did exist in the past in Denmark. This approach could be developed in countries having a central database such as Belgium, or in countries where such a database is going to be developed such as Greece. In France and Germany there are other initiatives not directly based on the energy certificates, but having similar objectives.

      Research projects such as the DATAMINE IEE-project are also active in this field. This project aims to collect data from energy certification in order to monitor performance indicators for new and existing buildings. A common data structure has been adopted in the twelve countries participating in the project, and comparisons of several levels make the basis for EP monitoring in relation to building information.

   d. Linking incentives to energy performance certification

      Energy certification alone is a tool which in itself, doesn't create any energy savings. Complementary (financial) mechanisms are necessary to stimulate the realization of energy savings and the certificates only offer a basis that can be used to link the

incentives (see list under §1.12). A distinction has to be made between public incentives and private initiatives coming from the banking sector for example.

In Belgium and the UK, discussions are being held regarding this possibility. In the Netherlands, such a scheme was in existence until the end of 2003, the EnergiePremieRegeling (EPR). Extra subsidy was available when energy savings measures were applied and based upon (voluntary) Energy Performance Advice (EPA). The EPR was popular and the subsidy budget allocated to it, quickly ran out. Recently, the voluntary EPA evolved into a method for EPBD-based energy performance certification (the subsidy scheme was not reintroduced).

Some countries state that the energy certificate is not judged to be sufficiently reliable to be used as a basis for linking public incentives (DK, FR).

Some (private) financing mechanisms are be related to the energy performance of buildings, but not necessarily to the energy certification (FR, G, NL).

2. Encourage reconstruction instead of heavy renovation works

Studies [8] have shown that a very efficient way to realize rapid improvement of the energy performance of existing building is the complete reconstruction of the building instead of simply performing renovation works, which are not able to obtain similar energy performance levels as those of a completely reconstructed building.

Encouragement of this can take place at several levels, including the financial level (e.g. similarly reduced VAT as applied to renovation works of existing building in some countries). This option should be promoted except for exceptional buildings which cannot be fully reconstructed.

France states that this policy is already applied, but mainly for social reasons and not for energy reasons. Other countries (DK, G) state that there are no direct incentives other than the open market (tax on energy consumption, higher building value of new buildings etc). Belgium and the UK state that discussions are ongoing, or have taken place in the past.

3. Adjusting the levels of rent

Special attention has to be paid to the market acceptance of this mechanism. This kind of mechanism could also be badly perceived by tenants (when rents are increased) as well as owners (when rents are reduced). Moreover, the energy part of the bill within the overall rental amount may be negligible in some cities in comparison with other main factors.

Most countries don't have legal mechanisms allowing for these adjustments. Private agreements can always take place between the owner and the tenant. Discussion about this possibility did take place in the past in the UK regarding the social renting sector. Discussion is ongoing in Belgium as well as in the Netherlands.

Only Germany has a rule allowing the investment costs of renovations (including energy efficiency measures) to be transferred to the tenant through an increase of up to 11 % per annum of the investment amount.

Denmark states the fact that financial reserves have to be constituted to act as a protection against fire and energy saving measures.

a. Right of the owner to charge energy investments to rental levels (agreed procedure)
b. Right of the tenant to deduct energy efficiency investments in rent paid to owner (agreed procedure)

4. Legislation concerning co-ownership

The following proposals deal with the problem of the decision mechanism with co-ownership where unanimity or qualified majority can often block any possibility to improve the energy efficiency of existing buildings.

All countries have their own rules regarding the way decisions are made in co-owned buildings. With the exception France, no country has legislation aimed at allowing a reduced majority. In France, the required majority drops from 66% to 50% for decisions regarding shared parts of energy savings work dealing with thermal insulation, heating systems, ventilation systems and domestic hot water. This work is paid back over less than 10 years.

Several countries (DK, FR, G) state that financial reserves may/must be constituted, but this is not specific to energy savings purposes.

No country has legislation to transfer cost savings to all co-owners (measure d).

   a. Reduced majority level to decide to implement measures proven to be energy efficient
   b. Reduced majority level to decide to implement measures proven to be energy efficient and cost efficient
   c. Requirement regarding the constitution of financial reserves for energy efficiency measures in co-owned buildings
   d. Rules to transfer cost savings to all co-owners or a financial reserve when building renovation is applied (to be developed for all kinds of heating and ventilation system costs)

5. Legal status of the co-ownership for bank loans used for energy refurbishments

Co-owners of building are generally not recognized as a legal entity. They can have difficulty obtaining bank loans to perform energy refurbishment. The investments have to be realized within the available financial reserves.

Except in the Netherlands, no country states that co-ownership is considered to be a legal entity.

In the Netherlands it is mandatory for all owners of an apartment to be a member of an owners' association in their apartment building. This association is a legal entity and is responsible, among other things, for the maintenance of (shared parts) the building. It is possible for the association to become certified, and therefore making it easier for an association of owners to obtain loans from a bank.

France states that specific loans are available for co-ownership. Germany states that co-ownership can not easily obtain additional funding from banks for such measures as they are not legal entities therefore, most measures can only be realized if the total investment costs do not exceed the financial reserves already maintained for the building.

6. Energy-friendly urban regulations

Some existing regulations may constitute barriers regarding building energy efficiency. It may concern exterior façade insulation when the thickness of the insulation takes over space within the public domain, or for aesthetic reasons (G, Gr). Other examples of regulations demand a minimum space between buildings with no possibility of reducing it even for external insulation.

Legislation at national level allowing specific energy-friendly measures, even if it contradicts local regulations, would help to solve this kind of practical problem. An example is given in Belgium (Walloon region) where a regional decree states that all local regulations have to permit solar panels for hot water production. In France, some local authorities set rules which only authorize building construction if higher levels of energy performance are achieved compared with the regulations.

In Germany and France, local regulations exist regarding the mandatory connection to district heating systems.

In the UK, many local authorities are adopting 'renewable energy mandates' which cover new developments or major refurbishment programs over a certain size threshold (typically >1000m2), and make minimum requirements for on-site renewable energy generation.

In the Netherlands the energy performance of an area or district (EPL, Energie Prestatie op Locatie) can be determined (by calculation) taking into account the energy distribution systems, as well as the energy performance of the individual buildings. When (re)developing such an area, the municipality may set regulations for the EPL. The EPL was introduced in 1998 for new construction projects, and in 2001 for existing areas.

7. Minimum energy requirements for renting

This measure provides the possibility to eliminate buildings that cannot comply with the minimum energy performance requirements in the market. Such radical measures could create important opposition from the owners of building for example. Attention has also to be paid to the problem of housing, since this measure would probably reduce the amount of housing available.

Such requirements can only be envisaged if the transition period is sufficiently long, and if there is a series of accompanying measures, e.g. legislation allowing owners to translate investments in energy efficiency into an enhanced level of rent, or coherent measures in terms of subsidies and fiscal incentives, or appropriate lending mechanisms, etc.

No country states minimum energy requirements regarding rental conditions. Other conditions may exist (e.g. regarding the safety of the heating and ventilation systems). Germany and Greece state that they expect that the market will control this problem and that buildings having high energy demands will not be easily rented.

8. Environmental permit

In several European countries, offices buildings, as well as industries, must obtain and renew environmental permits periodically (e.g. 15 years for office buildings in Belgium). This could also be used to impose minimum energy performance regulations on these buildings.

In the Netherlands, companies which use more than a certain amount of electricity, gas and/or water, require to make a plan for investing in energy/water savings measures. All measures which are reasonably possible, and have a payback time of a maximum of five years, must be carried out.

In the UK, a code for sustainable homes is already published. Compliance with the Code has been mandatory for publicly funded homes in England from April 2007, and will shortly be voluntary in the private sector.

9. Adoption of annual energy efficiency plans

Strategic planning is essential. Member states should adopt quantitative objectives and perform periodic assessments of their policies. Therefore, energy certification can be an attractive tool (see measure 1.11.2- 1.c).

Within the 2005 Action plan, Denmark has already defined the political framework for future energy savings measures. Germany has set targets for energy efficiency levels by 2020, including the building sector.

France has also defined similar long-term plans for all sectors, including buildings. Greece states that the adoption of such plans is voluntary. NL states that such plans have to be regularly updated by companies.

10. Mandatory energy efficiency impact assessment of new regulations

Within the current context, many decisions relative to the energy performance of buildings are taken by public authorities. The efficiency of some of the measures is sometimes very doubtful, and equivalent energy savings can sometimes be realized at a much lower cost. It could be a case of imposing solar boilers on northern countries, wherever the building may be located, bringing the overall energy performance of the building into question.

The assessment of the energy efficiency of the proposed politics should be implemented in order to guarantee high cost-effectiveness.

Nearly all countries state that (mandatory or otherwise) studies should be carried out before the introduction of new regulations. It is not clear if the specific point of energy efficiency is addressed within these studies, or if they only include the budgetary aspects.

2 Financial leverage

Within the building sector, most of the technologies enabling energy efficient buildings (as passive buildings or even positive energy buildings) already exist. Applied to the context of existing buildings, these technologies should permit substantial energy savings to be made.

The main difficulty lies in the lack of action, due partly to the lack of finance. Even with these technologies, there is still room for research and development, but without the support of efficient measures, even the new developments will not be able to realize substantial energy savings.

Some of the tools stated here could be linked to other tools for the energy performance certificate. The various measures/actions identified are shown below:

1. The fiscal tool

   Fiscal policies and inducements are very effective tools, maybe even more effective than regulatory measures. It has to be kept in mind that many people don't pay taxes due to low incomes. These people have therefore no benefit from tax reduction, unless a system enabling a negative tax, i.e. funding these people, as happens in France. Specific mechanisms such as those to increase subsidies (see point 2.c hereunder) should be developed.

   a. Deduction for energy investments

      Such a measure is currently ongoing in Belgium. The existing system is based on a descriptive list of technologies. Unfortunately, some good measures are not considered in this kind of list. The Government should focus more closely on the target and not dictate how these targets should be reached. Energy performance calculations should be used as a basis, even if this is more challenging to do in existing buildings than it is in new buildings. The financial support should be proportional to the savings, and not necessarily to the cost of the works. These two points pose specific questions regarding the possibilities for control.

      Such measures are already implemented in Belgium, France, Greece, the Netherlands and the UK. Germany has had such a mechanism in the past. Separate mechanisms exist for the residential sector, and non-domestic buildings.

   b. Taxation stimuli for energy-efficient buildings, and penalties for others

      This would constitute a supplementary incentive for the renovation of poorly performing buildings. The EPB and the energy certificate form a suitable basis for implementing this kind of mechanism. The social consequences of such a measure have also to be taken into account.

      One example of a stimulus already exists in France within the social building sector where the exemption of the land tax can be extended from 15 years to 20 years, provided that a set of environmental measures is applied, including energy reduction. Another such taxation stimulus exists in Greece within the residential sector.

      No example of an existing penalties mechanism has been stated.

   c. No increase of the building taxes in case of energy efficient refurbishment

      Renovating a building often results in increased taxes having to be paid. In the case of energy efficient renovations, such mechanisms should be avoided. This could be perceived as a complementary incentive.

      In its advice about the green paper on energy efficiency ([12]) the FIEC states:

      "Studies have shown that raising the energy efficiency of buildings (especially existing buildings) is the most cost effective way of reducing greenhouse gas emissions and the most cost effective way of doing just that is when buildings undergo major renovation. It is utterly incoherent therefore, if the member states are determined to reduce emissions as well as dependence on imported energy, to tax these activities, which is exactly what all member states do to a greater or lesser extent. It would make

much better sense to raise taxes on energy consumption and correspondingly reduce them on building renovation activities."

The French example can be stated: Since 2007 the municipalities can reduce the land tax on buildings where the owners have spent more than 10,000 Euros for the implementation of energy efficient measures.

2. The taxation tool
    a. Reducing VAT on:
        i. energy savings products

        Reducing VAT is one of the ways of encouraging energy savings products and/or energy-efficient renovation works.

        Since 2000, the UK has reduced VAT rates for solar panels, micro-wind and water-turbines, ground source and air source heat-pumps, micro-CHP and wood-fuelled boilers.

        In Belgium and France a reduced VAT rate is applicable on renovation works in existing buildings, and thus indirectly on energy savings products applied in these buildings.

        ii. energy supply

        Reducing VAT up to a certain limit on energy supplies could also be introduced in recognition of 'fuel poverty' issues. Whilst a higher rate would be imposed on energy use beyond these allowances in order to raise the economic priority given to energy efficiency. This tool should be linked to the energy performance certificate.

        No example of this measure has been stated in any of the seven European countries participating in this enquiry.

    b. Energy tax

    Imposing a general tax on energy would be a powerful tool in helping to make investment in energy efficiency much more interesting than currently. Such measures may also have social, as well as competitive consequences.

    In the UK a specific energy tax aiming at reducing energy consumption and called 'the climate change levy' is apply specifically to non-domestic buildings. The Netherlands also states explicitly that an existing energy tax has been introduced in order to influence energy consumption. In Germany there is an energy tax on fossil fuel energy carriers to help reduce the use of fossil fuels on the one hand, and to increase the rate of renewable fuels on the other.

    Most of the other countries state that they have energy taxes, but not specifically developed for this particular purpose.

    c. Buildings to be included in the CO_2 taxation market

    A CO_2-based taxation system for cars already exists in several European countries. Buildings could also have a CO_2-based taxation system to raise customer awareness and to give a political signal that society attaches a high priority to reducing CO_2 emissions. The energy certificate could be used as the basis for implementing this system.

    An example of this type of measure will soon be implemented in the UK and covers large organizations in the non-energy-intensive sector by using a mandatory cap and a trade emissions trading scheme (Energy performance commitment proposal[4]). Such a mechanism is also under preparation in France.

[4] Recently renamed the Carbon Reduction Commitment to avoid a second meaning of the acronym EPC (Energy Performance Certificate).

3. Subsidies for energy efficient technologies

Subsidies are the second most important aspect of financial leverage. Subsidies can be granted at different levels – national or regional (in federal states) – at the level of the communities or by energy suppliers.

All countries stated the existence of subsidies for energy efficient technologies; for the residential sector (B, DK, FR, G, GR, NL, UK), as well as in the non-residential sector (B, UK).

Subsidy programs could compensate for the fact that some people cannot benefit from the reduced taxation on incomes as their incomes are too low. This last proposal is being prepared in Belgium.

4. Granting soft loans

Soft loans can take several forms. The initiative can come from the private sector, e.g. the banking sector as well from public authorities. The variety of offers found in the private sector is high.

a. Higher amounts available for greater levels of energy efficiency

The first mechanism could offer higher amounts for financing renovation work in energy efficient buildings. It could be justified in that the owner would have lower energy costs and would therefore be more able to pay back the loan. The risks to the lenders would be lower.

This kind of approach can already be found in Belgium, France, Germany.

b. Lower interest rates on loans

A second mechanism in existence is in providing lower interest rates for energy efficient renovations or construction works.

This kind of approach is found in Belgium, France, Germany, Greece, the Netherlands and the UK.

c. Specific loans for energy efficient renovations and works pre-finance

The banking sector has proposed for a few year, a specific loan for energy efficient renovations. In Belgium, discussions are also ongoing concerning the provision of specific loans for covering the period between the investment, and paying back the tax reduction for the energy efficient investment.

Similar approaches are ongoing in France, Germany and Greece.

5. Third party financing (TPF)

Public Private Partnerships (PPP) bring public and private partners together into mutually-beneficial, long-term partnerships. Public authorities can award private companies with a contract to finance, design, build, maintain or manage public equipment (e.g. buildings) or services. This occurs within the scope of long-term collaboration, and against payments to the private companies. The aim is to optimise the performance of the public and private sectors in order to complete urgent or complex projects within the best possible time-frame.

There are various advantages to this kind of collaboration, including, acceleration of project realization through pre-financing, improved innovation via the creativeness of the private sector, an integrated approach to the global costs and not just to the initial investment, guaranteed performance, and optimal risk-sharing between the public and private sectors.

Worldwide there are three methodologies recognised with regard to Third Party Financing; namely, project financing, contractor financing and customer financing.

The system of third-party financing has been used in Germany for several years now. A PPP mechanism is also used in Flanders, in Belgium, for accelerated construction times and renovation programmes for school buildings, where severe energy performance regulations are imposed simultaneously. This approach has been recently adopted in France and is currently being introduced into draft legislation in Greece. It is also used in the Netherlands e.g. for the renovation of the Ministry of Finance buildings).

6. European structural funds

   These funds can also be used to finance the refurbishment of the social housing sector in new member states.

   No country states that they are using these funds for this purpose.

7. Higher energy prices paid for e- from PV or CHP

   Incentives for the production of green energy may encourage the development of such projects. This can be a case of a higher energy price guarantees for buying green electricity produced via Photovoltaic or via Combined Heat and Power production.

   This kind of approach is being used in France, Germany and Greece.

8. Insurance – lower insurance premiums for energy efficient renovated buildings

   Initiatives from insurance companies offering preferential premiums for energy efficient buildings are already being discussed in some countries (G, UK).

   This measure has not been implemented yet in any of the seven participating countries in this enquiry.

9. Energy tariffs

   The following proposals could be imposed on energy service providers.

   No example of these two proposals has been found. Regarding the second proposal, several countries stated that the existing situation exists in reverse, i.e. reduction of the energy price along with increasing energy consumption). Greece states that peak energy rates are charged in the industrial sector.

   a. Adjusted energy rates according to the level of energy performance certificate

      A reduced rate for gas and electricity supplies would be given to landlords and home-owners for meeting the recommendations in the energy certificate. This could also be linked to subscription to a scheme for regular inspection of boiler and air-conditioning equipment.

      On the other hand, landlords that fail to reach prescribed levels of performance, or who fail to implement energy efficiency measures as stated on the certificates, could be subject to an increased rate for energy supplies, and/or a higher taxation. Those properties affected would have a reduced market value, and therefore command lower rents in order to compensate the tenants for excessive energy costs. Landlords would of course be obliged to provide the tenants with a copy of the energy certificate and the applicable energy charge rate.

   b. Increasing rates along with the energy consumption

      This would effectively act as a graduated surcharge on wasted energy. However, the current situation in some countries such as Germany is that the rates are actually higher for lower consumption.

3 Non-governmental activities

This category of measures regroups initiatives form third parties. The various measures/actions identified are shown below:

1. Sector agreements

   Sector agreements can be an efficient way of making improvements via the supply side of the overall energy efficiency of existing buildings, e.g. by working at the component level (manufacturers), the installation level (building contractors), or at regional level. Legal aspects have to be taken into account, such as the free market.

   In Germany, the market is ruled by competition, and no sector agreements are more advanced than the governmental requirements that have been developed. Greece states moreover, that the awareness of, and market for energy efficiency has not yet been fully developed and government activities and laws remain the best incentives for initiating energy efficiency.

   Examples of sector agreements exist in the Netherlands, (the so-called MJA – Meer jaren afspraak) where agreements between the government and various sectors occur, (e.g. universities, banks and insurance companies, supermarkets and industry).

   .

   a. Components

      This kind of sector agreement is probably the easiest one to implement given the relatively limited number of actors. Component manufacturers commit themselves to offer energy efficient products and/or to eliminate energy inefficient products from their ranges. For example in the glazing sector where improved double glazing becomes the norm.

      In the lighting sector at European level, CELMA has reached an agreement that goes beyond the European directive relating to energy efficient ballasts, by no longer providing ballasts with an energy rating lower than B. Great developments in the use of electronic ballasts have been recorded since this agreement (market share has increased by approx 30% over 5 years[5]).

   b. Installers

      Components have to be properly installed. Highly efficient insulation material is not useful if it is not installed. Sector agreement at installation level could result in roofing contractors no longer proposing to repair roofs without including thermal insulation for example.

      This kind of agreement is already under discussion in Belgium. The aim is that all building contractors have to include roof insulation systematically in their estimates when work has to be carried out on flat roofs.

   c. Regional / municipal

      This kind of approach already exists in France. As the regions and municipalities do not have the power to make the regulations for building requirements, they use other approaches such as putting conditions on to land accessibility. Some municipalities or public agencies have defined contracts with property developers which give them access to the land provided that they develop low energy buildings on it. In Germany there are municipalities that sell their building sites only where the contractor guarantees the construction of energy efficient buildings (e.g. 30 % better than the existing national regulations).

[5] www.celma.org

2. Energy market mechanisms

These two actions can be coupled together, as happens in France.

a. Require utilities to realise energy efficient measures

Energy service providers have no direct interest in whether investments are made for energy efficiency in buildings. In several countries, requirements are imposed on energy providers regarding minimum energy savings that must be made.

In Belgium (Flemish region), energy providers have to commit themselves to saving 1% through providing subsidies. When imposed legally, this measure becomes legislation.

This kind of mechanism also exists in France and the UK.

b. System of the white certificates

According to the definition given in the EC "Directive of the European parliament and of the council on energy end-use efficiency and energy services" [2], white certificates are issued by independent certifying bodies confirming the claims of market actors for saving energy, as a consequence of end-use efficiency measures. In other words, energy saving obligations is translated into white certificate obligations. The process of implementation of white certificate schemes is quite recent, and is not yet fully established in many countries. Several mechanisms using the white certificates can be thought of and several elements have to be taken in consideration, including trading, binding agreements and eligible actors, costs, etc. These are described at reference [13].

Examples of this system already exist in France and are under development in Denmark, Germany and the Netherlands. Recently in 2007, market parties have been researching alternatives to the system of white certificates in The Netherlands.

4 Demonstration / research and development projects

The various measures/actions identified are shown below:

1. Demonstration project / good examples

   Demonstrating projects allows for dissemination and public awareness regarding innovative technologies. They play a role in transferring knowledge and newly established experiences.

   All countries have good examples in different sectors.

   The next graphic taken from the German contribution illustrates the relationship between demonstration buildings, and the minimum requirements as specified in German national regulations. It underlines the necessity of demonstrating building projects for the further development of the energy efficiency in all buildings, and in any particular country. The graph shows that it takes 10 to 25 years to transfer the demo project levels to the national regulations.

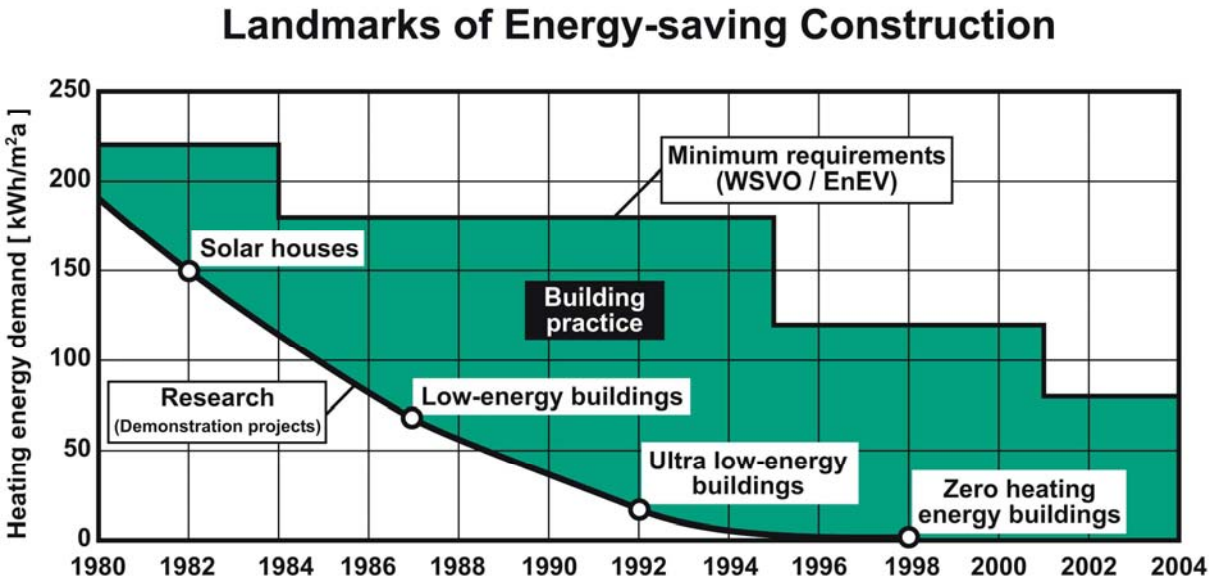


Figure 6: German evolution of the regulations and demonstration projects of energy efficient buildings

2. Research and development project / fundamental research

   As already stated in this report, the technology for making materials and products already exists today allowing for the construction of positive energy buildings. The most challenging point with regard to existing buildings, is the application of these existing technologies on a larger scale.

   This doesn't mean that research and development is not of interest. Research and measures each have different goals and so the development of new technologies is more relevant than ever.

   In this, all countries give examples of their projects.

5 Promotional measures / increased public awareness

Public awareness surrounding the problem of the energy consumption in buildings and the possibilities for saving energy is an important step towards stimulating the concrete realization of energy saving goals. The introduction of the energy certificate will contribute to the overall public awareness. The various measures/actions are shown below. In general, all communication relative to the topic is relevant in this context.

1. Campaign on related advantages to energy savings

   All countries state that campaigns are organised by different actors including government agencies, local authorities or non-governmental organisations.

   In some countries such as in Denmark, campaigns are organised by energy providers, being a part of their legal obligations.

2. Voluntary labelling / certification initiatives

   Voluntary labelling of products occurs in different countries including Belgium, France, Denmark, the Netherlands. In Denmark, building windows are labelled voluntarily. Boilers are voluntarily labelled in Belgium and the Netherlands.

   Nevertheless it difficulty is to have a common label instead of country-specific labelling for each product.

   The UK has developed a general 'energy recommended' label. This logo appears on a range of different products including boilers, heating controls, insulation materials, lighting, fridges, fridge freezers, tumble dryers and washing machines. The recommended scheme has already endorsed around 1800 products, 109 manufacturers and 34 retailers.

   Labelling also occurs at building level in Belgium (Walloon region), Germany (e.g. passive houses), and France and the Netherlands where the voluntary labelling of buildings takes place within the scope of research projects.

   Many other examples are stated in the country contributions.

3. Information on cost-efficient measures

   All countries state several sources of information regarding this aspect.

4.3 National examples – overview of measures at the national level

The list of measures presented under the 4.2 was developed on the basis of the seven countries participating to the Enper Exist project. Most of the existing examples have been stated in this list. Detailed information will be found in the description of the national situation of these countries enclosed in the appendix to the report.

The toolbox shown at §5 represents a overall view illustrating which measure has been implemented, and by which country. The toolbox makes direct links to the relevant part of each of the national contributions.

4.4 Examples of national long-term visions

As presented under the section 1 of this report, many measures exist in order to improve the energy efficiency of the existing building stock. Improving the existing building stock requires important efforts and long-term planning.

In the context of the Kyoto commitment, and the preparation of the post-Kyoto discussions, most European countries are developing such long-term strategies relative to the reduction of the CO_2 emissions in general, and the improvement of the energy efficiency of buildings in particular.

Discussions about ambitious measures are ongoing, and some of them are under development in the different member states. This section addresses the long-term vision of European countries regarding the improvement of energy efficiency in the existing building stock. It contains possible ways to improve the existing building stock and includes measures under discussion and/or under preparation.

Given the fact that the approaches taken in the various countries can be very different, no systematic comparison of the proposed measures has been realized, as was the case for the existing measures. The long-term strategies in the European countries participating in the project have been summarized in a set of documents that can be found in appendix. A short introduction to these appendices is given below.

4.4.1 Belgium

In Belgium, the Flemish Climate conference was started in June 2005. This conference addresses all energy consuming sectors, including the building sector. One of the major recommendations of this climate conference is to develop a large scale renovation program for existing dwellings.

In the framework of the Flemish Climate policy plan 2006 – 2012, a feasibility study for an energy renovation program for existing dwellings has been announced. The purpose of this study is to identify which combination of measures is the most appropriate for a substantial improvement by 2020 of all the existing housing stock. The general strategic objective for an energy renovation program in the housing sector, is formulated as follows: “By 2020 there will no longer be energy-inefficient dwellings in the Flemish Region”. A list of possible accompanying measures is under development.

The complete description is available in the appendix to the report.

4.4.2 Denmark

Since 2005, three long-term political announcements have been presented in Denmark. These are, Energy Strategy 2025, Action plan for renewed energy savings measures (2005) and the government's new draft energy proposal entitled "A visionary Danish energy policy" published in January 2007. The plans, all of them passed by parliament, are increasingly firm in their pronouncements and in their proposals for action. Both plans and the visionary policy, also refer to higher levels of efficiency in the building stock. Thus most of the proposals of the Action plan, which is incidentally a fulfilment of the EPBD, have been transformed into action to a great extent.

Recently however, many politicians from all parts of the world have changed their minds about global climate change and environmental issues. The policy presented in, 'A visionary Danish energy policy', stated in January 2007 by the Danish government, can be seen as a result of exactly that global change of attitude. Nonetheless, it now seems clear that energy efficiency within the existing building stock is a much more important issue.

More details are available in the appendix to the report.

4.4.3 France

In France, two main documents are used for long-term actions planning:

- the French climate plan as defined in 2004
- the Energy orientation law published on July 15th 2005 (EOL)

These two documents deal with energy in all sectors; the one selected here contains the actions which are applicable to existing buildings.

Building renovation constitutes a large part of the climate plan 2004. This plan is a clear roadmap for the various actors, and especially public-related bodies. The Energy Orientation Law is the legal vehicle which enables the government to implement many of the actions defined within the climate plan.

The French contribution enclosed in the appendix of the main report, provides more information.

4.4.4 Germany

The German government has set up a long-term strategy for the improvement of the energy efficiency of all buildings, which foresees a yearly rate of renovation of 5 % of the building stock over the next 20 years. Currently the German government is developing a new holistic energy policy concept. The announcement of this concept is planned for the second half of 2007. Therefore the long-term vision can only be based on the publications available from the government, the responsible ministries and the results of the so-called energy summits.

With regard to the energy efficiency of the German building stock, a set of specific goals have been planned, including:

- Accelerated realisation of the significant energy saving potential in the existing building stock
- Introduction of the energy efficiency as major factor in the real estate market
- Significant reduction of the energy consumption of public buildings
- Use of the presidency of the European Union in order to boost energy efficiency at the international level

The level of scope and the supporting measures should both be announced soon. More information is available in the appendix to the report.

4.4.5 The Netherlands

Energy saving in existing buildings has already been in the picture in the Netherlands over the last ten years, and a base has been made for future long-term plans. It started out by using a voluntary method along with an instrument to calculate the energy performance of existing dwellings (EPB, later EPA) as an initiative of EnergieNed (the umbrella-organisation of energy companies). The Dutch national government picked up on this initiative and over several years a subsidy scheme (EnergiePremie, EPR) was linked to it. Then a new method and tool was also developed for non-residential buildings.

The calculation of the Energy Performance Certificate is based on EPA. This is one of the pillars of the Dutch energy efficiency policy over the longer term.

Intensification of the energy efficiency policy in the construction environment was announced in December 2006. The following tools have been announced:

- Energy saving targets will be imposed on energy companies.
- The application of stimulating tools to overcome investment restrictions for building owners and users.
- Knowledge transfer for building owners and users, e.g. concerning user behaviour, cost and benefits of energy saving measures and new technologies and measures.

Additional policies and tools are also under development. Complementary information can be found in the appendix to the report.

4.4.6 The UK

The UK Government set out its policy to deliver a secure, low carbon energy mix for the UK on 23 May 2007 when it published its Energy White Paper, “Meeting the Energy Challenge”. Looking ahead to 2020, the White Paper announced specific measures that will ensure that individuals, businesses and the government reduce their carbon emissions and save energy:

- Helping more people save energy by proposing to double energy suppliers’ current obligation to provide customers with energy efficiency measures through a new ‘Carbon Emission Reduction Target’ from 2008-2011.
- A mandatory national scheme – the ‘Carbon Reduction Commitment’ (CRC) – to require large non-energy intensive commercial organisations (e.g. banks, supermarkets, hotel chains, etc.), government departments and local authorities to reduce their emissions.
- A requirement for new meters to come with a real-time display from 2008 and a short term offer of free displays from energy providers for households to 2010. The government expects everyone to have a smart meter with a display within 10 years.

The UK’s long-term energy policy is to achieve a 60% reduction in CO2 emissions by 2050. Buildings are responsible for about 50% of total emissions, and may well need to deliver cuts greater than this. The government recently announced that new buildings should be zero-carbon by 2016 and has promised proposals for the decarbonisation of existing buildings later this year. More information is available in the appendix to the report.

4.5 Development of policy packages

The list of measures presented in this roadmap may all be relevant in specific situations. It is however clear that policy packages combining different measures will give the best results. Reaching improved energy efficiency in the existing building sector will require initiatives in different fields; legislative as well as increasing public awareness, and also the financial side. In this sense, the list presented must not be considered to contain the only measures. The way to compose a comprehensive list of measures depends very much on the national context.

In some cases, simple measures can be preferred to a multiple of small measures that may create the risk of confusion and administrative complications.

5 The roadmap toolbox – easy access to information

5.1 Methods to gain access to information

The information regarding the measures described in this report can be found several ways:

- The report can be read from the beginning to the end according to the reader's interest.
- Some readers may be interested in a specific situation in a country and will only consult the national appendices.
- Some readers may only be interested in the existing measures; others may be more interested in long-term planning and vision.
- Some readers will be interested in how one specific measure is implemented in various countries.
- Other readers will be interested in all of the measures concerning a specific type of building regardless of the country.

Providing this type of access to information via a report is not easy, even when there are hyperlinks available in an electronic version, so that a toolbox has been developed to make it easier.

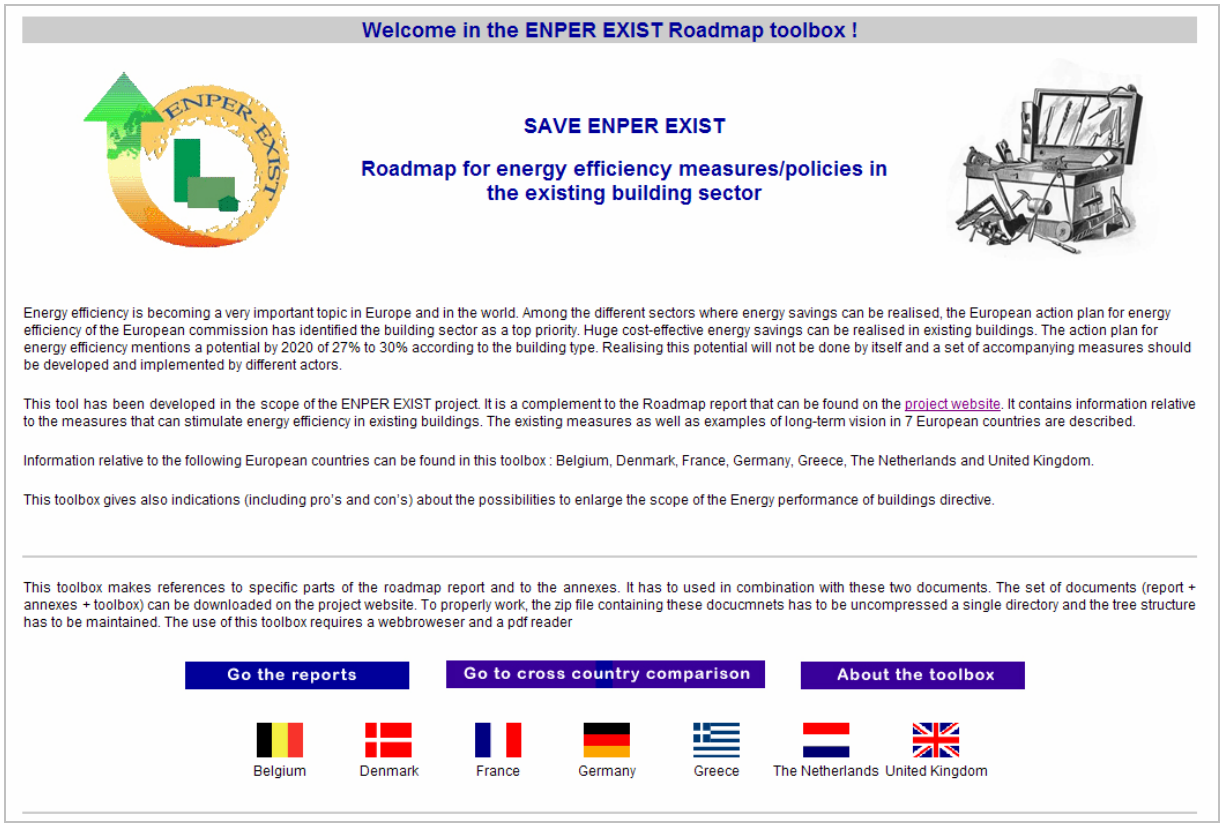


Figure 7: Roadmap homepage

This toolbox provides links to the various parts of the report and to the appendices. The tables provide a overall view of the contents of the reports, and the hyperlinks allow direct consultation to the information requested.

The toolbox has been conceived as an open tool that can continue evolving and does not end with the completion of the ENPER EXIST project. Specific measures will be developed to react to the evolving situation within the European building sector.

5.2 Content of the toolbox

The Roadmap toolbox is an HTML website that makes links throughout the reports in order to structure the information. The toolbox allows the following methods for accessing information:

- Overview of the contributions regarding the measures currently applied in countries
- Overview of the contributions regarding the long-term planning in the countries.
- Links to the possibilities for widening the scope of the EPBD.
- Information relative to specific building market.
- Cross-country comparisons of the application of possible measures for improving the energy efficiency of existing buildings.

Type of measure		Belgium	Denmark	France	Germany	Greece	The Netherlands	United Kingdom
1. The regulatory measures								
1.1 Legal requirements (technical)								
1. Adoption and/or reinforce requirements								
a. Building level - overall energy performance		exist	exist	exist	exist	ud	exist	exist
b. Building level - subset performance		exist	exist	exist	exist	no	no	no
c. Component level		exist	exist	exist	exist	exist	exist	exist
d. Enlarge the application field of the requirements		exist	exist	no	exist	ud	no	no
2. Adaptation of energy and environment standards		no	no	no	exist	exist	no	no
3. Visible meters in the building		no	exist	exist	no	no	no	ud
4. Requirements compliance check		exist	exist	no	no	no	no	no
5. Public / governmental buildings								
a. Stricter requirements for governmental buildings		no	exist	exist	exist	no	no	exist
b. Integration of the energy performance of buildings in public procurement procedures		exist	exist	exist	exist	no	exist	no
c. Retrofitting of public buildings		exist	exist	exist	exist	no	no	no
1.2. Other legal supporting measures								
1. Energy certification scheme								
a. Way certificates are communicated / displayed		exist	exist	exist	exist	exist	exist	exist
b. Towards the mandatory realization of the recommendations enclosed into the energy certificates		no	exist	no	no	no	no	no
c. Base the development of adapted supporting tools on the knowledge of the building stock gained by the collection of energy certificate		ud	exist	no	ud	ud	no	no
d. Linking incentives to energy performance certification		ud	ud	no	exist	no	exist	ud
2. Encourage reconstruction instead of heavy renovation works		ud	no	exist	no	no	no	ud
3. Adaptation of the renting level								
a. Right for the owner to charge energy investments in renting level (agreed procedure)		no	no	no	exist	no	no	no
b. Right for the tenant to deduct energy efficiency investments in rent paid to owner (agreed procedure)		no	no	no	no	no	no	no

Figure 8: Cross-country comparison of the measures implemented in seven European countries

5.3 How to use the toolbox

The toolbox is an HTML website requiring internet browser software to be installed on a computer. It must always be used in parallel with the roadmap report and the appendices of the report. The toolbox can be downloaded with these reports together in a zip-file. The content of the zip-file should be unzipped into one folder. This method must be maintained in order for it to work properly. A PDF reader program should be used to consult the Roadmap report. It is also possible to read the reports without using the toolbox.

6 Suggestions for EPBD revision

This chapter gives an overview of the possible modifications that can be discussed in case of an EPBD revision. As there are advantages and disadvantages for all the suggestions, it has been decided not to make any recommendations, but simply to provide a list of pro's and con's for each suggestion, so that might be helpful for decision-makers.

The possible modifications are grouped by category:

- Technical specifications (§6.1)
- Impact assessment of EPBD (§6.2)
- Market uptake of EPBD (§6.3)
- Support measures to individual decision makers (§6.4)
- Actions at EU level – international collaboration (§6.5)

6.1 Technical specifications

In terms of technical specifications, the following possible modifications are discussed:

- To reduce the article 6 threshold of 1000 m²
- To impose minimum overall energy performance targets to MS
- To impose minimum requirements for building envelope to MS
- To impose minimum targets for individual components for new buildings to MS
- To impose minimum targets for individual components in cases of renovation to MS
- To impose minimum targets when no renovations are planned to MS
- To impose minimum requirements in terms of renewables to MS
- To strive for an effective limitation of the available assessment procedures
- To impose MS to evaluate whether urban regulations represent barriers/stimuli for energy efficiency
- To impose energy metering of individual entities to MS
- To stimulate MS to encourage reconstruction instead of heavy renovation works
- To stimulate MS to encourage energy certification of districts or areas
- To impose MS to evaluate if regulation regarding the owner / tenant relationships can be adapted to facilitate energy savings investments

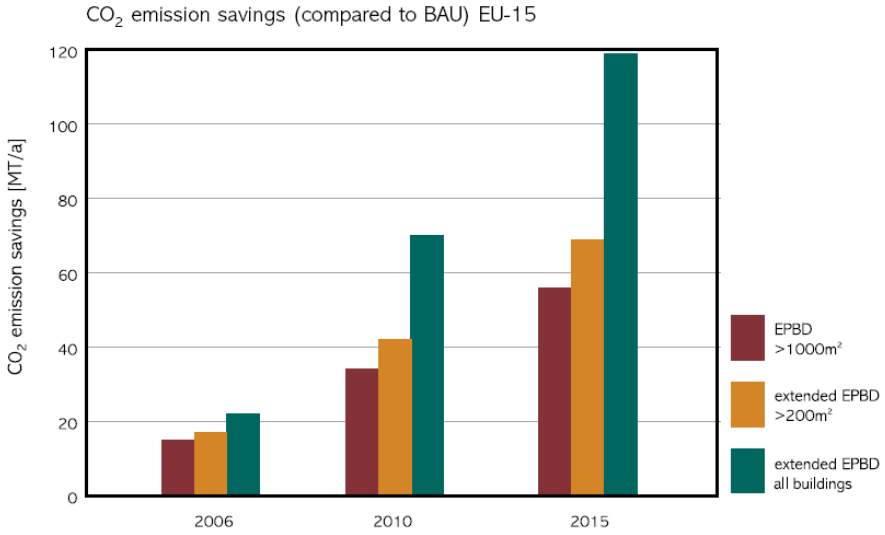
- **To reduce the article 6 threshold of 1000 m²**

  In the EPBD, several requirements only apply to buildings over 1000 m², i.e.:

  - Article 5: Member States are only obliged for buildings over 1000 m² to ensure that the technical, environmental and economic feasibility of alternative systems is considerer and taken into account before construction starts. Such alternatives may include, decentralised energy supply systems based on renewable energy, CHP, district or block heating or cooling, if available, and heat pumps under certain conditions.
  - Article 6: Member States shall take the necessary steps to ensure that energy performance is upgraded in order to meet minimum requirements in so far as this is technically, functionally and economically feasible, when buildings with a total useful floor area over 1000 m² undergo major renovation works.

- Article 7: Member States shall take measures to ensure that an energy certificate, not more than 10 years old, is placed in a prominent position and clearly visible to the public in buildings with a total useful floor area over 1000 m² occupied by public authorities and by institutions providing public services to a large number of people and therefore frequently visited.

ECOFYS made a study [7] whereby the impact of a reduction of the article 6 threshold has been estimated. Results are shown in Figure 5.



	2006	2010	2015
EPBD >1000m²	15	34	56
Ext. EPBD >200m²	17	42	69
Ext. EPBD all buildings	22	70	119

Figure 9: Impact of the EPBD on the CO2 emissions of EU-15 building stock (source: Ecofys)

Pro's and con's : **To reduce the 1000 m² threshold**	
☑ Lowering the threshold will substantially increase the impact of the EPBD	☒ The administration involved in handling this requirement for small buildings may be too great
☑ Many countries already have renovation requirements for buildings less than 1000 m² (no extra administrative burden)	☒ At present, many countries already have renovation regulations for buildings of less than 1000 m², so by lowering this threshold will not necessarily have a major impact in some countries
	☒ Minimum requirements may be easier to apply for individual components in case of renovations
	☒ Discussion is expected regarding the new threshold (if any)

- **To impose minimum overall energy performance targets to the MS**

  At present, the EPBD only requires that MS impose minimum requirements for new buildings (article 5) and for the major renovations of large buildings (article 6). There is no requirement in terms of a minimum performance level that MS must impose. One can imagine that minimum requirement would be included (for example, in the second round the energy performance criteria could be tightened by 10% compared to the initial requirement) within the framework of a revision.

Pro's and con's : **To impose minimum overall energy performance targets to the MS**	
☑ Such requirements will impose certain MS to make their national regulations more severe	☒ The development of a coherent approach for expressing such requirement in the EPBD text is not evident: it should take into account climate differences and differences in building styles, etc[6]
☑ If carried out properly, it will accelerate the implementation of more severe energy performance targets	☒ Such a minimum requirement should take account of the way market control is organised. At present, some countries have practically no control over legislation so that severe regulations are therefore less problematic, whereas other countries already have strict control
	☒ A minimum requirement level in a EPBD context will be the outcome of compromises between MS. It will probably mean that the minimum requirement will be less severe than the requirement already applied in certain countries. For some national governments, it may be difficult to justify regulations that go beyond those specified in the EPBD

[6] It is expected that the SAVE ASIEPI project will deliver appropriate instruments for comparing the severity of requirements in the MS, and therefore could support the implementation of minimum regulations.

- **Minimum requirements for building envelope**

  It is not evident whether upgrading the thermal quality of a building shell after construction is worthwhile, whereas it is much easier to replace, e.g. a heating boiler after 15 to 20 years. Therefore it is possible to imagine that in addition to an overall energy performance requirement, a specific requirement regarding the overall performance of the building shell (e.g. average U-value) is necessary.

Pro's and con's : **Minimum requirements for building envelope**	
☑ The building shell has a very long life-span and improvements after construction are often not worthwhile	☒ Reduces flexibility allowing builders to reach most cost effectively a given energy efficiency target
☑ Economic studies show that a well-insulated building shell is in most cases cost-effective	☒ It may exclude certain systems and products from the market
☑ It avoids (or at least reduces the need) for carrying out very expensive renovation works in case of more stringent energy performance targets (horizon 2020 – 2050)	

- **Minimum requirements for individual components in new buildings**

  In addition to, or in parallel with an overall requirement regarding the thermal performance of the building shell, minimum requirements could be imposed on individual components, e.g. maximum U-values for glazing, windows, walls, roofs, floors, …

  There may also be additional requirements for other components, e.g. boilers, lighting,…

Pro's and con's : **Minimum requirements for individual components in new buildings**	
☑ This will avoid the use of poor quality products and systems	☒ It is not clear that equal treatment will apply to all "poor" products
☑ It will become a powerful driving-factor for the industry	☒ How should the criteria be set objectively?
☑ Through increased sales, a faster drop in price could be expected	☒ There will be a lot of lobbying
☑ There are a whole range of products where it is clear that they should no longer be used	☒ There is a danger that the simple component approach reduces the opportunity and success of energy efficiency in whole building concepts

- **Minimum requirements for individual components in case of renovation**

  In building renovation works where only parts of a building and its installations have been renewed, it is not clear how to impose an overall energy performance target. However, the imposition of a minimum performance requirement for individual components could be considered.

Pro's and con's : **Minimum requirements for individual components regarding renovation**	
☑ Could be appropriate for the renovation market ☑ Could be proposed as an alternative method for an overall performance target ☑ Guarantees better energy efficiency, also for minor renovations	☒ Same considerations as for new buildings ☒ Important to avoid market barriers ☒ Imposing minimum performance requirements at a European level may sometimes be more appropriate than at national level (e.g. one minimum requirement out of a choice three possible levels, so that industry in several countries can actively develop solutions cost-effectively). The possibility for member states to go beyond the minimum performance regulations set at the European level should be allowed

- **Minimum targets also when no renovations are planned**

  For a substantial part of the market, there probably is no upgrade of the energy performance levels expected over the next 10 to 30 years without any specific incentives and/or regulations. Minimum performance targets could be imposed.

Pro's and con's : **Minimum targets also when no renovations are planned**	
☑ This appears well justified in an overall long-term energy policy ☑ It often improves the living standards of inhabitants ☑ If well planned, can be economically acceptable ☑ The example of Denmark can be used for public buildings, (all measures identified by the energy performance certificate on display, having pay-back time of less than 5 years, must be implemented within 5 years)	☒ How minimum requirements are expressed ☒ Probably will not gain the required societal acceptance if not well implemented. Specific care is needed for the more difficult target groups, e.g. owners with low income, elderly people, etc ☒ Probably only possible in a medium to long-term action plan (horizon 2020) ☒ It could be easier to apply the measure at the time of purchase where finance is available ☒ Minor impact as this can be only legally required for cost-efficient measures (not possible for exterior walls and windows)

- **Minimum requirements for renewables**

  A wide scale market uptake of renewables seems a crucial element in the overall strategy for reducing the CO_2 emissions in the building sector. In the framework of a EPBD revision, more action from MS regarding market uptake of renewables could be imposed.

Pro's and con's : **Minimum requirements for renewables**	
☑ Will accelerate market uptake of renewables	☒ Renewables are currently not always the most cost-effective strategy
☑ Where the requirements are gradually implemented, this can be cost-effective as part of a long-term strategy	☒ Renewables not evident in all projects. How to make the specifications sufficiently intelligent
☑ The possible promotion of day-lighting and passive solar energy can also lead to better windows and shading systems	☒ A short-term general requirement may have adverse effects in terms of lack of supply and high prices; also lack of experience of practical experience of builders, etc
	☒ Renewables are usually only understood to be connected to building service systems, although passive solar energy and day-lighting have much higher potential

- **Striving for effective limitation of the number of national assessment procedures**

  In practice there are a great number of national approaches. To a large extent, these differences were due to a lack of European procedures at the time of the implementation of the national procedures. By now CEN standards have become available for most technical issues and support activities including the EPBD Concerted Action, the EPBD Buildings Platform and a wide range of SAVE projects that have resulted in more knowledge for MS and the major stakeholders. Therefore, the conditions for substantial procedural convergence are now right.

Pro's and con's : **Striving for effective limitation of the number of national assessment procedures**	
☑ Would make the approaches more European	☒ It is clearly not possible to strive for a single European method, but a limitation in the number of alternative approaches would be desirable
☑ Would facilitate development of European software tools	☒ In many countries it is a politically sensitive issue
☑ Would facilitate benchmarking requirements	☒ Large scale convergence is probably not possible unless long-term targets date are set (e.g. 2015)
	☒ National cultures must also be taken into account

- **The imposition of MS to evaluate whether urban regulations represent barriers/stimuli for energy efficiency**

Urban regulations often represent a major barrier for certain renovation works or investments in energy efficiency, e.g. regulations which don't allow the application of external insulation on the façades, of rows of houses, or the installation of solar collectors, etc. See also the evaluations made by the seven countries about existing energy-friendly regulations on page 35.

Pro's and con's : **Imposing MS to evaluate whether urban regulations represent barriers/stimuli for energy efficiency**	
☑ Would allow the removal of barriers and create extra opportunities	☒ Urban regulations have other roles which should be considered ☒ National (original) building culture has to be taken into account

- **Imposing MS to evaluate whether regulations regarding owner / tenant relationships can be adapted to facilitate Energy savings investments**

  Regulations regarding owner/tenant relationships often prevent the owner from benefiting from the investments that have been made in energy savings.

Pro's and con's : - **Imposing MS to evaluate whether regulations regarding the owner / tenant relationships can be adapted to facilitate Energy savings investments**	
☑ Would allow to make energy efficiency investments more attractive to owners	☒ Requires negotiations between the owners and the tenants' association in order to find agreement so that both parties can benefit

- **Imposing energy metering of individual entities to MS**

  In many older apartments and office buildings, there is no individual metering of energy consumption. See also the evaluation made for the seven countries about this topic on page 31.

Pro's and con's : **Imposing energy metering of individual entities to MS**	
☑ Would strongly raise awareness ☑ Would allow easier benchmarking	☒ Might be relatively expensive in some cases

- **Stimulating MS to encourage reconstruction instead of large-scale renovation**

  The overall and energy-consuming qualities of part or all of the building stock in many MS regions is such that it might be better to consider reconstruction rather than renovation. This is even more so if the long-term targets in terms of energy efficiency are considered (e.g. in France a reduction of energy consumption in existing buildings by a factor 3 to 4 by 2050). See the evaluation made for seven countries about this on page 34.

Pro's and con's : **Stimulating MS to encourage reconstruction instead of large-scale renovation**	
☑ Would avoid non-optimal renovation works being carried out	☒ Important to avoid misuse of such measures
☑ As part of a long-term strategy (2050), demolition of poor performing buildings might be the most cost effective approach	☒ Embodied energy implications
	☒ Building culture mainly in old city centres does not allow demolishing of existing buildings (e.g. listed buildings, historical facades, etc)

- **Stimulating MS to encourage energy certification of districts or areas**

  Including energy supply systems in energy efficiency plans for new or existing building locations can put the energy efficiency of an entire district at a higher level. Energy saving measures and renewable energy sources are often regarded in their relationship with individual buildings. However, energy efficiency can be boosted further by putting it into relationship with other buildings in the district and with the energy supply systems. This can be made clear through the energy certification of a district. Local authorities may set a requirement for the energy performance of a district (taking the specific conditions in the district into account).

Pro's and con's : **Stimulating MS to encourage energy certification of districts or areas**	
☑ Interactive approach stimulating communication and cooperation between local parties	☒ May be difficult to get all stakeholders involved: a local network of communication should be set up
☑ Bringing energy efficiency to a higher level (not only for the individual buildings, but also including the energy supply systems and the relationship between buildings)	☒ Should be coordinated (extra costs)
☑ At new construction sites by starting from scratch and making a well-considered overall plan	☒ Energy certification of districts is probably a step too far for some of MS that have only recently started working on the energy certification of buildings
☑ Stimulate the application of district heating and renewable energy sources	

6.2 Impact assessment of EPBD

In order to improve the impact of the EPBD on the building performances, the following measures could be envisaged:

- To impose requirements in terms of market impact assessment on MS.
- To impose requirements in terms of control of legislation on MS.
- To impose EP-based monitoring to increase knowledge of (existing) building stock

- **Requirements in terms of market impact assessment**

  At present, most MS have no precise idea of how the EPBD regulations are implemented, e.g. what percentage meets the regulations, what is the average energy performance level, how many buildings perform better than the minimum regulations, etc?

Pro's and con's : **Requirements in terms of market impact assessment**	
☑ Will raise awareness	☒ Not evident to make coherent specifications
☑ Will probably improve understanding of bottlenecks and the reasons for success stories	☒ May be politically sensitive for certain MS
☑ Will motivate MS to have effective requirements	
☑ Will help facilitate meeting targets for energy services directive	

- **Requirements in terms of control of legislation**

  In its present version, the EPBD does not impose on MS that control schemes for verifying the market implementation should be set up. This probably means that in a number of countries the real performance is substantially above the imposed requirements.

Pro's and con's : **Requirements in terms of control of legislation**	
☑ In terms of EPBD impact, this would be very useful for several MS	☒ There might be strong opposition from several MS
☑ If done properly, stakeholders may support a strict control scheme	☒ It is not evident that a system of fines would be accepted by stakeholders, unless after very careful preparation and consultation

- **Imposing EP-based monitoring to increase knowledge of building stock**

  From the results of the ENPER-EXIST project, it has been concluded that there are large gaps in the knowledge concerning the existing building stock (including the energy performance of the building stock). This is particularly the case with respect to non-residential buildings. To develop effective energy efficiency policies with respect to existing buildings, it is necessary to have a reliable overview of the energy performance from a certain starting point. Energy performance-based monitoring using energy certificates might serve this purpose. The IEE-project DATAMINE (2006-2008) is taking the first steps in this approach.

Pro's and con's : **EP based monitoring to increase knowledge of building stock**	
☑ An enormous amount of energy certificates will become available over the coming years, providing detailed information about existing (and new) buildings ☑ The database might serve multiple purposes (e.g. building stock management by housing corporations)	☒ The costs involved in setting up and managing a database ☒ It will take several years to obtain energy certificates for the entire building stock, and some buildings will never receive certification as they will not be sold on, or rented out. Therefore, insight into the energy performance of the building stock will become more complete within time (it will always be a random indication, but it is better than nothing)

6.3 Market uptake of EPBD

In order to improve the market uptake of the EPBD, the following measures could be envisaged:

- To motivate and/or impose MS to set up actions which increase the visibility of the EPBD requirements positively
- To motivate and/or impose MS to collect the practical utilization of EPBD in activities beyond the legal requirements
- To give MS more freedom in areas of financial stimuli (VAT, etc).

- **To motivate and/or impose MS to set up actions which increase the visibility of the EPBD requirements positively.**

  The EPBD requirements might be considered by many stakeholders as an additional burden on the building sector. There is a wide range of possibilities for MS to give a positive image of EPBD implementation.

  Therefore, in addition to legal requirements, the instruments developed in the framework of the EPBD may also be used for other purposes, e.g. requirements from major building investors, criteria for incentives, etc.

Pro's and con's : **To motivate and/or impose MS to set up actions which increase the visibility of the EPBD requirements positively**	
☑ The various stakeholders will become more positive towards the EPBD requirements	☒ MS may see it as an additional workload

- **To motivate and/or impose MS to communicate the practical utilization of EPBD in activities beyond the legal requirements**

  As part of the reporting of EPBD implementation, MS could be asked to provide information about actions going beyond the legal requirements.

Pro's and con's : **To impose MS to collect information about practical utilization of EPBD in activities beyond legal requirements**	
☑ Would provide good ideas for other countries	☒ …
☑ Would motivate other countries to stimulate actions going beyond the regulations	

- **To give MS more freedom in areas of financial stimuli (VAT, …)**

Pro's and con's : **To give MS more freedom in areas of financial stimuli (VAT, …)**	
☑ At present MS freedom is quite limited in this area	☒ May be in conflict with other principles of the European Union

6.4 Support measures to individual decision-makers

In order to give more support to individual decision-makers in the MS, the following measures could be envisaged:

- To impose regulations on MS in terms of incentive schemes for owners and tenants
- To impose measures on MS for higher implementation rates for recommended improvements

- **To impose requirements on MS in terms of incentive schemes for owners and tenants**

  The take-up level will probably be very low if there are no attractive incentives (subsidies, fiscal reduction, loans, etc), particularly for the existing building stock.

Pro's and con's : **To impose requirements on MS in terms of incentive schemes for owners and tenants**	
☑ Will strongly increase investments in energy efficiency in most cases ☑ There is growing interest from various stakeholders (banks, social housing sector, …)	☒ It might be costly ☒ Probably not evident to have politically acceptable requirements in EPBD (unless very general and not binding) ☒ Not evident to find a formulation which takes into account large differences in culture and policy within MS

- **To impose measures on MS for higher implementation rates for recommended improvements**

  At present, the requirements given in the energy performance certificate are not binding.

Pro's and con's : **To impose measures on MS for higher implementation rates for recommended improvements**	
☑ It would substantially increase EPBD impact	☒ It might be a politically very sensitive ☒ Appropriate solutions should be found for dealing with liability issues regarding the recommendations given.

6.5 Actions at EU level - International collaboration

The following possible actions have no direct link to updating the EPBD, but may be relevant to the overall implementation of energy efficiency targets for the building sector:

- To strive actively for more intensive international collaboration in order to make better use of European experiences and experiences of other countries
- To set up the international benchmarking of requirements and implementation in the field
- To set up some kind of European Centre for the Energy Efficiency of buildings

- **To strive actively for more intensive international collaboration in order to make better use of European experiences and the experiences of other countries.**

  The challenge of CO_2 reduction is on a global scale. It is therefore not sufficient that only the MS in the EU can implement energy efficiency plans properly. It is clear that the EU is leading the way for increased energy efficiency, and that a wealth of knowledge has already been collected. Therefore, it might be appropriate to have an active strategy for international collaboration in order to assist other countries in an accelerated and successful implementation of their own energy efficiency action plans. This would be a good initiative for not only all the OECD countries, but also for other countries such as China and India where very substantial building activities are now being carried out.

Pro's and con's : **To strive actively for more intensive international collaboration in order to make better use of European experiences and the experiences of other countries**	
☑ It can substantially contribute to the accelerated implementation of effective energy efficiency plans	☒
☑ It might provide benefits for the export of European energy-efficient products	

- **To set up international benchmarking of requirements and implementation in the field**

  In an international context, an improved understanding of the relative severity of national requirements may help push the lesser performing countries towards better energy efficiency standards.

Pro's and con's : **To set up international benchmarking of requirements and implementation in the field**	
☑ It could substantially contribute to more advanced national energy efficiency plans	☒ Regulations often depend heavily on national boundary conditions such as energy carrier availability

- **To set up a European Centre for the Energy Efficiency of buildings**

  Energy efficiency of buildings will probably be a major topic over the next two decades. A permanent support structure could be very useful, where the emphasis is on data collection, support for the MS and interface with non-European organisations. It should not be in competition with IEEA.

Pro's and con's : **To set up a European Centre for the Energy Efficiency of buildings**	
☑ It would allow for long-term planning ☑ It could greatly reduce redundancy in national activities ☑ If it interacts well with other organisations (IEEA, Eurostat, IEA, …), it could be beneficial for many other organisations and countries	☒ It is important to avoid unnecessary overlap with other organisations ☒ Implementation is dependent on national policies. Experience shows that European centres like the European Research Centre in Ispra have no influence on national strategies, or on the national decision-makers ☒ Existing networks of national key actors as in the Concerted Action project, are much more effective in the transfer of information to national and international experts and users

Conclusions

1. When the ENPER EXIST proposal was first submitted in 2004, there was little political interest from most countries for the development of roadmaps for improving the energy efficiency of existing buildings.
2. Currently energy efficiency in general finds itself at the top of many political agendas. Given the importance of buildings with regard to energy consumption and CO_2 emissions, and also the importance of the existing building stock, it is clear that the development of effective action plans for the existing building stock is becoming a priority for many decision-makers.
3. There is clearly an enormous cost-effective potential in terms of improvement in the energy efficiency of existing buildings, as well as the improvement of indoor climate in many European buildings.
4. With respect to the 2020 horizon, there is a need for innovative concepts in terms of a large-scale market implementation of well-proven technologies (thermal insulation, efficient boilers, heat pumps, energy-efficient ventilation, efficient lighting, use of renewables, etc). No new major technological innovation is required.
5. With respect to the improvement of the energy efficiency of existing buildings over a longer timeframe (2050), there is a major challenge in terms of technological innovation.
6. This report gives suggestions and guidelines of the ingredients to formulate strategies for action plans for the existing building stock. It is evident that a clear understanding of the cultural peculiarities of the building stock and of the stakeholders is very important in achieving successful implementation.
7. There are parts of the building market which are clearly difficult to motivate towards investing in energy efficiency measures. But only by combining a clear understanding of the specific difficulties of these market segments in combination with the appropriate stimuli, will this lead to the required results.
8. It is probably also essential to include mandatory requirements over the longer timescale, and to communicate the overall approach very clearly as part of an overall action plan.
9. Successful implementation requires the combination of a whole range of actions, and attention must also be given to raising awareness, providing clear information for the decision-makers, along with attractive stimuli, as well as legal requirements.

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List of appendices

The following contributions can be found in the appendix to this report:

Overview of existing instruments aimed at improving the energy efficiency of existing buildings – situation in seven European countries

- Situation in Belgium
- Situation in Denmark
- Situation in France
- Situation in Germany
- Situation in Greece
- Situation in The Netherlands
- Situation in The United Kingdom

Long-term vision of European countries regarding energy efficiency in the existing building stock

- Long-term vision in Belgium
- Long-term vision in Denmark
- Long-term vision in France
- Long-term vision in Germany
- Long-term vision in the Netherlands
- Long-term vision in the United Kingdom

Analysis of the situation of eight specific building market-sectors

- Social housing managed by public bodies
- Residential sector - lack of enthusiasm and invisibility of energy saving measures
- Residential sector – owners with no financial means
- Apartment buildings – the problems of co-ownership and decision-making within apartments
- Apartment buildings – importance of the division of heating costs
- Rented office buildings
- Educational buildings
- Public buildings