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Boosting Building Renovation: What Potential and Value for Europe?

Study for the ITRE Committee

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DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

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STUDY

Abstract

Renovation of buildings is key to meet the EU's energy efficiency targets. This paper reviews the literature on the state of the building stock and assesses various policy options and their potential for boosting the energy efficient renovation of buildings in Europe. This document has been commissioned by Policy Department A at the request of the Committee on Industry, Research and Energy (ITRE) of the European Paliament.

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LIST OF ABBREVIATIONS

Anah	Agence nationale de l'habitat, national agency of housing
BCR	Brussels Capital Region
BG	Bulgaria
bn	billion
BPIE	Buildings Performance Institute Europe
BREAM	Building Research Establishment Environmental Assessment Method
CA EPBD	Concerted Action European Performance of Buildings Directive
C&D	Construction & Demolition
CO_2	Carbon dioxide
DK	Denmark
DHW	Domestic Hot Water
EASME	Executive Agency for Small and Medium-sized Enterprises
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECO	Energy Company Obligation
EE	Energy Efficiency
EED	Energy Efficiency Directive
EE	Estonia
EEOS	Energy Efficiency Obligation Scheme
EFSI	European Fund for Strategic Investments
e.g.	exampli gratia, for example
EIB	European Investment Bank

EL	Greece
EnEV	Energieeinsparverordnung, Energy Saving Ordinance
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
ERDF	European Regional Development Fund
ES	Spain
ESCO	Energy Service Company
EU	European Union
EUR	Euro
FI	Financial Instruments
FNEE	Fondo Nacional de Eficiencia Energetica, National Energy Efficiency Fund
GDP	Gross Domestic Product
GHG	Greenhouse gas
GJ	Gigajoules
GW	Gigawatt
GWh	GigaWatt-hour
H2020	Horizon 2020
HQE	Haute Qualité Environnementale, High Quality Environmental standard
HU	Hungary
IEE	Intelligent Energy Europe
JRC	Joint Research Centre
KfW	Kreditanstalt für Wiederaufbau, Reconstruction Credit Institute
Kton	Kiloton

kWh	kiloWatt-hour
LEED	Leadership in Energy and Environmental Design
LT	Lithuania
LV	Latvia
MunSEFF	Municipal Sustainable Energy Financing Facility
NEEAP	National Energy Efficiency Action Plan
nZEB	Near Zero-Energy Building
m^2	Square meters
MEPS	Minimum Energy Performance Standards
MS	Member State
PAYS	Pay-As-You-Save
PJ	Petajoules
PV	Photovoltaic
RED	Renewable Energy Directive
RES	Renewable energy sources
RERM	Roadmap to a Resource Efficient Europe
RDI	Research Development and Innovation
SME	Small and Medium Enterprise
UK	United Kingdom
VAT	Value Added Tax

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EXECUTIVE SUMMARY

Buildings account for 40% of the EU's energy consumption, 36% of its CO_2 emissions and 55% of its electricity consumption. This makes emissions and energy savings in this sector vital to meeting the EU's climate and energy targets. The stock of buildings in the EU is relatively old, with more than 40% of it built before 1960 and 90% before 1990. Older buildings typically use more energy than new buildings. The rate at which new buildings either replace this old stock, or expand the total stock, is low (about 1% a year). This implies that if the energy consumption of buildings is to be reduced the renovation of existing buildings is key. The current renovation rate of existing buildings is low, with only about 1-2% of the building stock renovated each year, although it is estimated that renovation accounts for 57% of all construction activity. The vast majority of these renovations do not utilise the full potential energy savings that could be achieved.

This paper assesses various policy options and their potential for boosting the energy efficient renovation[1] of buildings in Europe. The paper begins by describing the existing building stock and its renovation potential. It also addresses the multiple benefits of renovation and the barriers that are slowing its take up.

The analysis has focussed at the EU level, with examples drawn from specific Member States (MSs) when relevant. Policy schemes in the United Kingdom, Denmark, Slovakia, Spain and Belgium were looked at in greater detail and are presented in Annex E.

Costs and benefits of renovation

The overall costs associated with building renovation are split between the property owners, public authorities and tenants (when the buildings are rented or leased) as explained below.

Costs and burdens for property owners and landlords	Costs and burdens for authorities	Costs and burdens for tenants
•Assessment costs •Installation costs •Financing costs •Hidden costs •Costs of understanding regulations	•Set up costs •Implementing administrating, monitoring costs •Other costs e.g. advising on regulations	•Potential rent increases •Hidden costs

Building renovations have several benefits in addition to energy savings. The diagram below shows the most relevant ones.

[1] The focus of this paper is on energy renovations of buildings, understood as renovations that are carried out to improve the energy performance of buildings and therefore reduce energy consumption and consequent CO2 emissions.

Environmental benefits	Economic benefits	Social benefits
•Energy savings & GHG emissions reduction •Reduced usage of materials	•Employment •GDP and public budgets •Innovation •Sectoral modernisation •Energy Security •Productivity benefits	•Health benefits •Reduction energy poverty •Wellbeing / Comfort benefits •Energy bill savings •Increase in property value & tenant satisfaction

Barriers to renovation in the EU

The key barriers to energy renovation of buildings are illustrated in the following diagram:

Financial barriers	Technical barriers	Process barriers
•Renovation costs •Access to finance •Low energy prices	•Lack of technical solutions •Cost of technical solutions •Lack of knowledge of construction professionals	•Fragmentation of the supply chain •Burdening of home owners

Regulatory barriers	Awareness barriers
•Varying ambition of performance requirements •Multiple definitions for renovation	•Lack of awareness

Policy options to boost renovation

There are a wide range of voluntary and regulatory initiatives or schemes that are designed to stimulate the energy efficient renovation of buildings in the EU. These are summarised in the table below.

Type	Examples of policy option
Regulatory	• Mandatory building codes • Minimum Energy Performance Standards (MEPS) • Refurbishment obligations • Energy Efficiency Obligation Schemes (EEOS)
Financial and fiscal	• Subsidies and financial instruments • Grants for research, innovation and demonstration programmes (e.g. for nZEBs & smart meter roll-out) • Tax incentives • Energy Service Companies (ESCOs)

Information campaigns & Labelling	• Awareness raising and information campaigns • EU Energy Performance Certificates (EPCs) • (Voluntary) energy labelling schemes • EU ecodesign and energy labelling
Others	• Voluntary and negotiated agreements • Energy audits • Skills development and capacity building programmes

This paper includes an assessment of each of the policy options showing that different policy measures serve to tackle different barriers. The conclusion is therefore that a full range of policy measures are needed to boost renovation. The optimum policy package should therefore address each of the barriers - prioritising those with most potential, take synergies into account, cover the full range of building types - prioritising those with greatest energy savings potential, reflect the mix of building stock across Europe, and prioritise the lowest cost / highest impact policies. The policy package should consist of a combination of mandatory and voluntary schemes, recognising that voluntary schemes may need to become mandatory when results are not achieved over a set timeframe.

Recommendations for EU policymakers

A combination of tougher obligations, stronger incentives and more creative use of instruments alongside effective transposition, implementation and enforcement of existing legislation are prerequisites to boost renovation:

- Renovation regulations should be concrete, coherent, ambitious and broader in scope. Regulations also need to be enforced and reporting made easier for EU MSs.
- Theres is a need to improve coherence between policy instruments, broaden the scope of the provisions of the EU policy instruments and link finance to energy efficiency.

Recommendations for MS policymakers

Local/regional/national authorities in MSs have an important role to play in the market transformation of the EU building stock. These authorities should:

- Carry out a comprehensive census of their existing building stock.
- Raise the ambition of their regulations and revise their cost-optimal calculation methods.
- Ensure that policy instruments aimed at boosting renovation include incentives to maximise the ambition of the renovation activities; Information dissemination and awareness raising activities on financing options for renovation should also be promoted.
- Encourage the set-up of one-stop-shops and contribute to clear roadmaps for renovation in order to facilitate the renovation (decision) process.

INTRODUCTION

The Energy Efficiency Directive (EED) (2012/27/EU) identified the existing building stock as "the single biggest potential sector for energy savings… crucial to achieving the Union objective of reducing greenhouse gas emissions by 80-95% by 2050 compared to 1990."

Buildings account for 40% of the EU's energy consumption, 36% of its CO_2 emissions[2] and 55% of its electricity consumption,[3] making emissions and energy savings in this sector vital to meeting the EU's climate and energy targets. With the slow addition of new buildings to the existing building stock, renovation to improve the energy efficiency of the existing stock of buildings is imperative to meet the EU's targets of a 20% improvement in energy efficiency by 2020 and a 27% improvement by 2030. Renovation is also an important way to tackle fuel poverty. To date, however, renovation rates in the EU are low[4] and renovating the existing building stock to make it more energy efficient remains a challenge, even more so when considering the ambitious levels set by the EPBD which includes aims for nearly zero-energy buildings (nZEBs).[5] Increasing the rate at which existing buildings are renovated to at least 2-3% (the higher figure for the public sector) per year until 2030 is a key objective of the EU's Resource Efficiency agenda.

Against this backdrop, this paper sets out to describe the existing building stock and the set of policies that influence it, as well as to assess various policy options and their potential for boosting the renovation of buildings in Europe. The specific objectives of the paper are to:

- Review existing, planned and potential policies to boost building renovation;
- Quantify (when possible) and provide a qualitative assessment of their costs and benefits;
- Assess their economic, social and environmental impacts;
- Review the impact of different rates and depths of building renovation in the EU;
- Identify bottlenecks and barriers to achieving the full benefits of renovation;
- Recommend policy options to remove these barriers and boost renovation.

It aims to provide policy authorities and MSs with focussed, coherent and specific interventions to stimulate building renovation and also to inform the ongoing revisions of the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD).

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2 https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings.

3 http://cordis.europa.eu/result/rcn/186598_en.html.

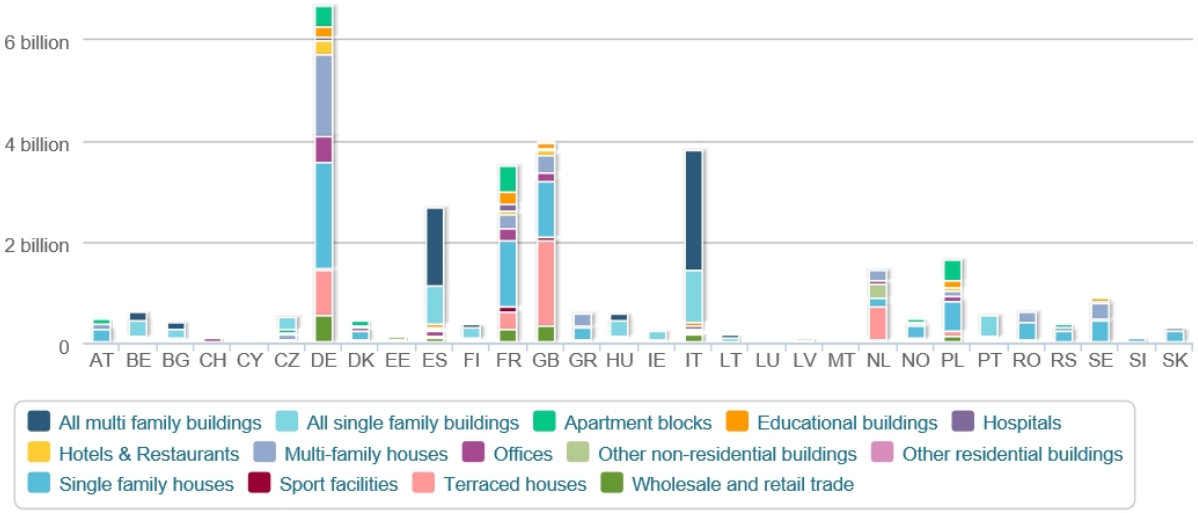
4 COM (2014) 330 final - EU Energy security strategy.

5 CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).

1. THE EU BUILDING STOCK

Buildings in the EU have a floor area of 25 billion m^2,[6] with about ¾ of this being residential buildings.[7] As the figure below shows the floor area per country roughly follows country size.

Figure 1: Building stock floor area (m^2) per building type per Member State



Source: http://www.buildingsdata.eu/data-search

Much of the European building stock is in need of renovation. More than 40% of it was built before 1960 and 90% before 1990[8], and most of these buildings, will still be standing in 2050[9]. Each year, new construction in Europe represents about 1% of building stock[10]. The total building stock is growing over time, with the rate at which new buildings are erected exceeding the rate at which old buildings are demolished. The key point is that both demolition and construction rates are low. For example, for residential buildings between 1980 and 2005, in eight EU countries, the average annual demolition rate was about 0.1%, with the annual new construction rate between 1% and 1.5%[11].

1.1. Residential buildings

1.1.1. Energy consumption

For households, the annual energy consumption for all purposes in the EU28 is 17,793 kWh per active dwelling, and the median cost per unit of energy for households across the EU28 is estimated to be in the order of 0.24 €/kWh.[12] A BPIE study[13] included analysis of the

6 http://www.odyssee-mure.eu/publications/efficiency-by-sector/buildings/buildings-eu.pdf.

7 http://www.odyssee-mure.eu/publications/efficiency-by-sector/buildings/buildings-eu.pdf.

8 Itard, L., 2008. Building Renovation and Modernization in Europe: State of the Art Review; BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

9 The Economist, 2013. Investing in energy efficiency in Europe's buildings. A view from the construction and real estate sectors.

10 The Economist, 2013. Investing in energy efficiency in Europe's buildings. A view from the construction and real estate sectors.

11 Itard, L. and Meijer, F., 2008. Towards a sustainable Northern European housing stock: figures, facts and future.

12 http://cordis.europa.eu/result/rcn/186598_en.html.

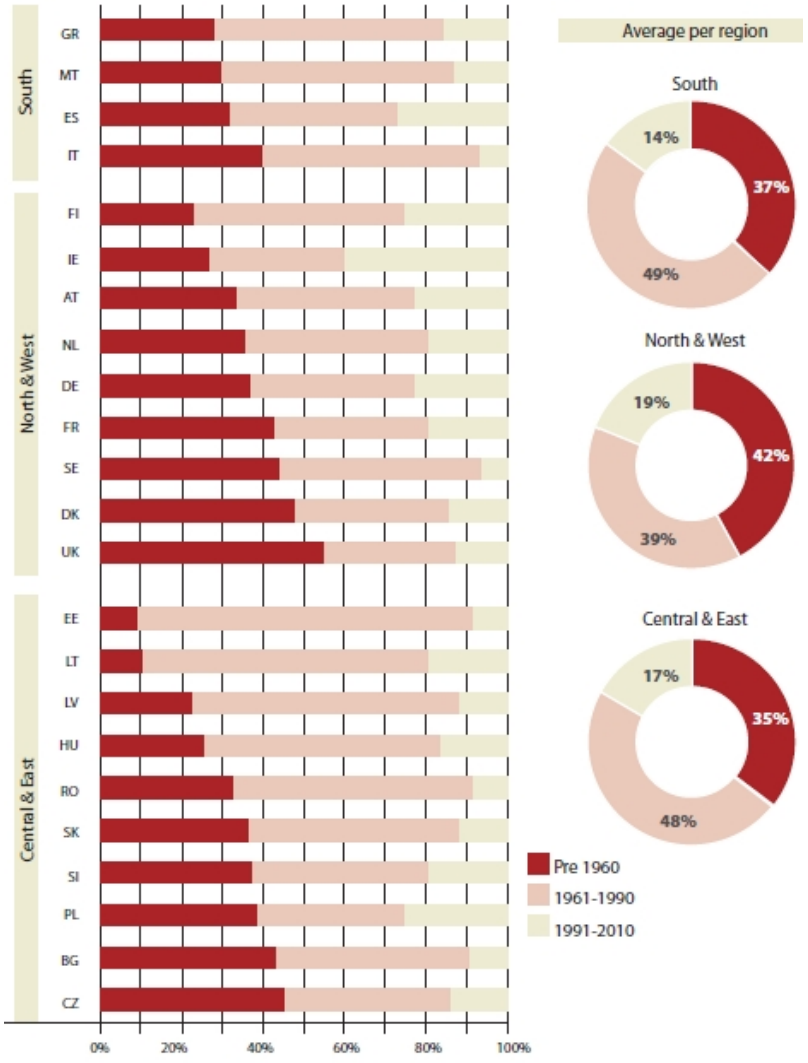
13 BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings

energy performance of buildings by age. This confirmed the intuitive assumption that in all the EU countries surveyed, older buildings (residential and non residential) use more energy per building than modern buildings. This is due to the lack of building energy performance standards when older buildings were erected which leads to lower standards of insulation and air tightness.

1.1.2. Age of the building stock

The oldest residential building stock (pre 1960) is most prominent in the North & West regions of Europe. The countries with the largest share of recently constructed residential building stock (1990-2010) appear to be Ireland, Spain, Poland and Finland.[14]

Figure 2: Residential stock according to age band



Source: BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings

[14] BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

1.2. Non-residential buildings

Non-residential buildings account for 25% of the total floor area of the European building stock.[15]

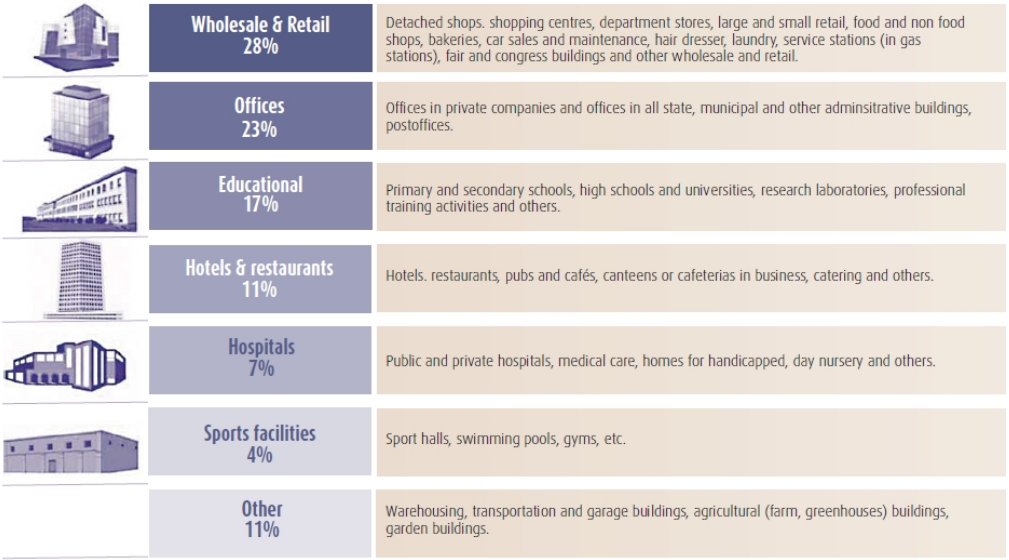
1.2.1. Energy consumption

Research shows that the share of energy use in non residential buildings is roughly in line with their share of floor area. The highest total energy use is within shops (28%), offices (26%), educational (12%) and hotels and restaurants (12%).[16] These are followed by hospitals (10%) and sport facilities (6%) with 6% by other building types.

The average specific energy consumption in the non-residential sector is 280kWh / m² (covering all end-uses) which is at least 40% greater than the equivalent value for the residential sector. In the non-residential sector, electricity use over the last 20 years has increased by a remarkable 74% in line with the increased use of IT equipment and air conditioning.[17]

1.2.2. Building use

Figure 3: Distribution of floor area (m²) per category of non-residential buildings in the EU



Source: Helgesen, PJ and IEA SHC Task 47, 2014. Upgrading of the non-residential building stock towards nZEB standard: Recommendations to authorities and construction industry; BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

[15] BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

[16] Helgesen, PJ and IEA SHC Task 47, 2014. Upgrading of the non-residential building stock towards nZEB standard: Recommendations to authorities and construction industry; BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

[17] BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

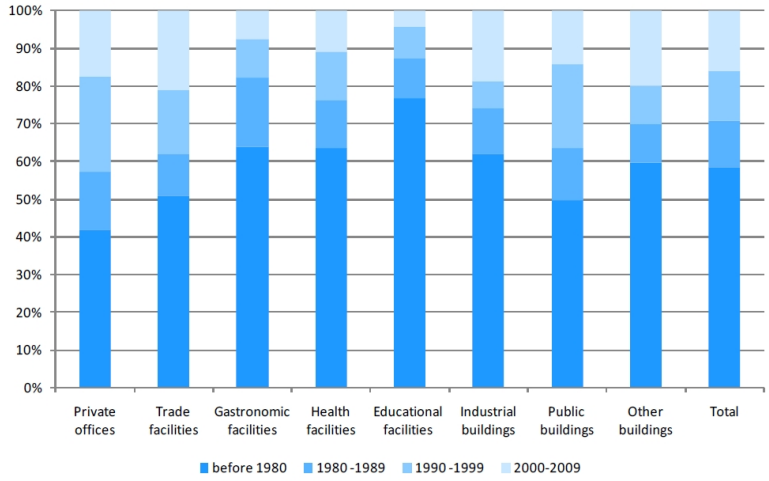
1.2.3. Ownership structure

Non-residential buildings are owned by either the private or public sector, though some are shared. Research[18] suggests that there is a wide variation between MSs in the mix, varying between private dominance (>70% private – EL, DK, LV, LT) to public dominance (>70% public – HU, BG, EE). The ownership is relevant because some energy efficiency policies only apply to public buildings.

1.2.4. Age of the building stock

The European non-residential building stock is generally newer than the residential stock although the majority was constructed before 1980. Educational buildings account for the largest share of the oldest buildings. A relatively large share of public buildings and office buildings were built in the 1990s.

Figure 4: Age profile non-residential buildings EU27



Source: Ecofys, 2011. Panorama of the European non-residential construction sector

[18] BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

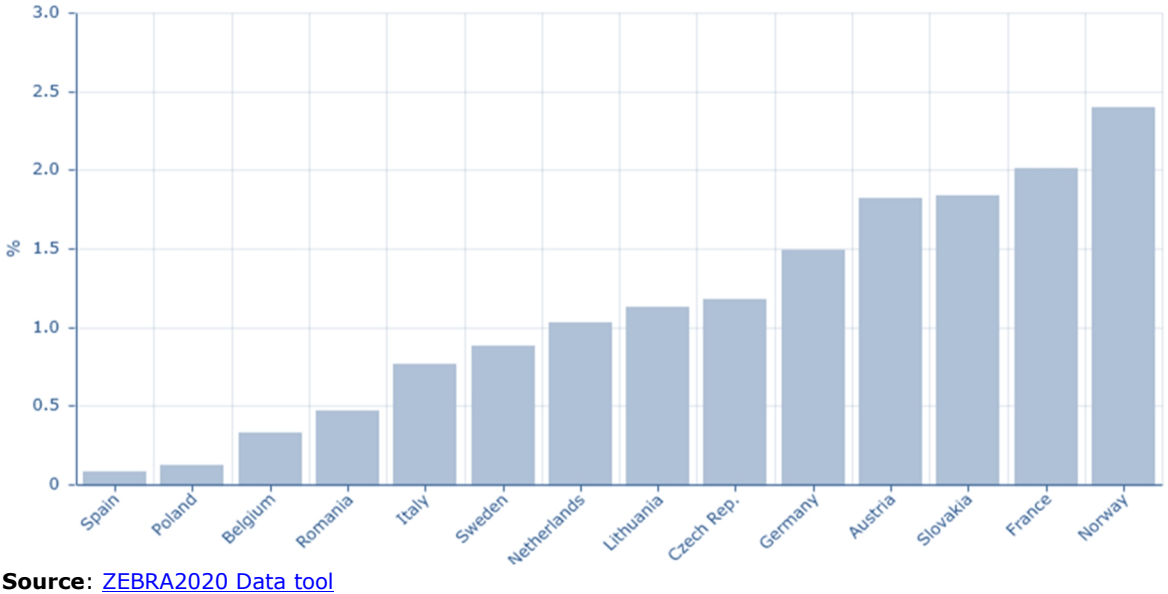
2. THE STATUS OF RENOVATION IN THE EU

2.1. Rates and depth of renovation across the EU

2.1.1. Scale of renovation

Our review of the literature indicates that there is a lack of consistent and accurate data on building renovation rates across Europe. Official statistics agencies do not report on this and the estimates come from a combination of housing condition surveys, construction market value surveys and one-off surveys. The most recent review of the data we could identify is from 2012.[19] This collates and compares various estimates (with a focus on the housing stock). They conclude that the 3% per year figure included in a 2012 EC consultation on finance for energy efficiency in buildings[20] is over optimistic. The range that emerges from the literature they review[21] is 0.5% to 2.5% a year, with the rate varying as a result of time limited renovation programmes and other factors, with a typical figure being 1% (about 250 million m^2) per year.[22] Figure 5 shows the variation between MSs in the major renovation rates of residential buildings.

Figure 5: Major renovation rates of residential buildings across MSs



Source: ZEBRA2020 Data tool

2.1.2. Depth of renovation

The definition of energy efficient renovation varies across EU legislation, and in practice, with a variety of 'depths' of renovation defined and carried out.

Recital 16 of the Energy Efficiency Directive (Directive 2012/27/EU) defines 'deep renovations' in a very broad way, as "renovations which lead to a refurbishment that reduces both the delivered and the final energy consumption of a building by a significant percentage

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[19] Meijer, F., Visscher, H. E. N. K., Nieboer, N., & Kroese, R., 2012. Jobs creation through energy renovation of the housing stock. Neujobs Working Paper D 14.2, December.

[20] EC, 2012. Consultation paper financial support for energy efficiency in buildings, Brussels, February (results but no consultation paper).

[21] Itard, L. and F. Meijer, 2008. Towards a sustainable Northern European housing stock: figures, facts and future; UEA Low Carbon Innovation Centre and Build with CaRe, 2012. Refurbishing Europe. An EU Strategy for Energy Efficiency and Climate Action Led by Building Refurbishment. Executive Summary; BPIE, 2011. Europe's Building under the Microscope: A Country-by-Country Review of the Energy Performance of Buildings.

[22] RESIDE project, 2015. Deliverable 1.1. A baseline scenario for energy efficiency renovations in Europe's residential buildings.

compared with the pre-renovation levels leading to a very high energy performance". Of the current renovations one estimate is that only 1% meet this definition.[23]

Article 2 of the EED, defines 'substantial refurbishment' as "a refurbishment whose cost exceeds 50% of the investment cost for a new comparable unit". Article 5 describes 'comprehensive renovations' are renovations which cover "the building as a whole, including the building envelope, equipment, operation and maintenance".

Article 2 of the EPBD recast defines major renovation, as either a renovation in which "the total cost of the renovation relating to the building envelope or technical systems is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated", or a renovation in which "more than 25% of the surface of the building envelope undergoes renovation".

Less extensive renovation can be described as 'piecemeal' or 'single-measures' (e.g. just PV panels or double-glazing). This reduces energy consumption by less than 'deep' renovation.[24]

These different levels of renovation reflect current maket reality. The BPIE (2011) produced the following definitions of renovation levels alongside an estimate of the market share (as a percentage of all renovations) of each.

- *Minor renovations – 85% of the market*: the implementation of 1 or 2 measures (e.g. a new boiler) resulting in a reduction in energy consumption of between 0% and 30% (with average costs of €60/m^2).
- *Moderate renovations – 10%*: involving 3-5 improvements (e.g. insulation of relevant parts of the dwelling plus a new boiler) resulting in energy reductions in the range of 30%-60% (with average costs of €140/m^2).
- *Extensive renovations – 5%*: in this approach the renovation is viewed as a package of measures working together leading to an energy reduction of 60% - 90% (with average costs of €330/m^2).
- *Almost Zero-Energy Building renovations - negligible*: the replacement or upgrade of all elements which have a bearing on energy use, as well as the installation of renewable energy technologies in order to reduce energy consumption and carbon emission levels to close to zero (with average costs of €580/m^2).

This illustrates that there are many opportunites to improve energy efficiency when renovating buildings that are not taken up.

2.1.3. The renovation market

A recent study[25] estimated that the **EU energy renovation market was worth approximately EUR 109 billion in 2015, consisting of 882,900 jobs**.[26] The French, German and Italian energy renovation markets account for almost half of the EU total. The German market is by far the largest, accounting for 22% of the total.

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[23] The Economist, 2013. Investing in energy efficiency in Europe's buildings. A view from the construction and real estate sectors.

[24] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

[25] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

[26] The weighting coefficients used are 15% to assess the energy efficiency component of the renovation market is and 8.1 jobs per million invested, based on the US study by ACEEE, 2008. The size of the US energy efficiency market: generating a more complete picture.

Renovation accounts for 57% of the total construction market, with residential buildings, account for 65% of the renovation market in 2015.[27]

It has been estimated that the annual investment in the energy renovation of the building stock will need to grow from EUR 12 billion (~30 € per capita) (in 2014) to EUR 60 billion (~150 € per capita) in order to meet the EU target of a 20% energy efficiency improvement by 2020.[28]

2.2. Renovation potential in the EU

Considering the age profile of buildings in the EU (35% of the EU's buildings are over 50 years old[29]) and the slow replacement rates, **the renovation potential of buildings in the EU is huge - up to 110 million buildings could be in need of renovation** (based on the estimates that count 210 million buildings in the EU[30]). The extent to which the potential to reduce the energy consumption of existing buildings is realised depends upon the number of buildings renovated and the depth of the renovation. There are numerous studies which model combinations of renovation rates and depths. Depth is in turn related to the combination of energy-efficiency measures in a renovation. A life cycle approach (that considers the future life of the building, comparing energy savings againt the cost of various energy efficiency measures) when assessing which energy efficiency measures should be included in a renovation is the best way to find the optimal combination of renovation measures. However, this analysis is not frequently carried out.[31]

The cost-optimal level for energy performance is defined as "the energy performance level which leads to the lowest cost during the estimated economic lifecycle". Article 4(1) of the EPBD states that MSs shall take the necessary measures to ensure that minimum energy performance requirements for buildings are set with a view to achieving cost-optimal levels.[32] However, the interpretation of these requirements differ across Member States.[33] There is significant potential to make the targets implied by cost optimal approach more stringent if all MSs adopted a consistent (and more testing) approach[34] with a 15% difference between the two extreme interpretations.[35] Two thirds of the MSs have the potential to make some improvements, and for about half of the MS, that improvement potential is large. Closing this gap between the cost-optimal performance levels and the minimum energy requirements can be achieved through various means[36], such as lower investment costs, higher energy prices, lower interest rates, higher shares of renewable energy, the inclusion of the increased value of property due to increased energy performance and the consideration of other co-benefits (energy security, employment creation, reduced air pollution, health, etc.).

The study "Renovation tracks for Europe until 2050 – building renovation in Europe – what are the choices" states that a **deep renovation of the existing stock together with new buildings that are nearly zero energy, can save 80% of the final energy use for**

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27 Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

28 CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).

29 https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings.

30 Loebel, O., 2016. Opportunities and Challenges in Existing Buildings, the Renovate Europe Campaign, Advancements for Metal Buildings Congress, Ljubljana 22nd October 2016.

31 Pombo, O., Rivela, B., & Neila, J., 2016. The challenge of sustainable building renovation: assessment of current criteria and future outlook. Journal of Cleaner Production, 123, 88-100.

32 EPBD Recast, 2010. Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (EPBD)

33 Ecofys, 2015. Assessment of cost optimal calculations in the context of the EPBD (ENER/C3/2013-414)

34 EPBD Recast, 2010. Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (EPBD)

35 CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD)

36 Ecofys, 2015. Assessment of cost optimal calculations in the context of the EPBD (ENER/C3/2013-414)

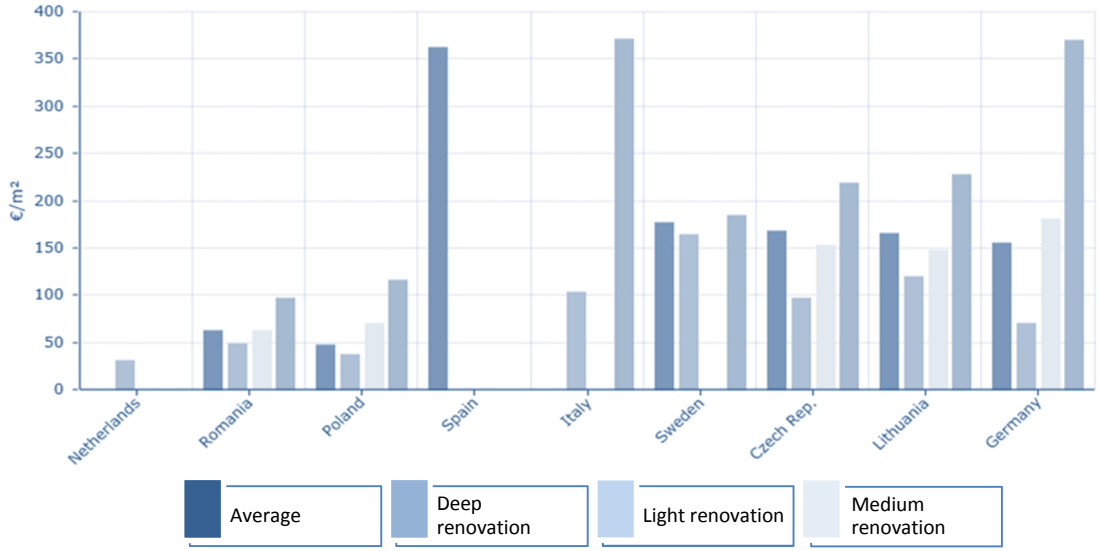
space heating by 2050, compared to 2012.[37] The deep renovation of 3% of the building stock (25 billion m^2), would generate energy savings of approximately 100 TWh/y by 2020. If around 20% of the building stock was deeply renovated by 2030, it would save 750 TWh/y.[38]

A Eurima study[39] supports the 80% final energy savings target (suggested by the European Parliament). The size of the **EU energy renovation market could increase by almost half the current levels if a 40% energy savings target was adopted for 2030**. Meeting this target would require **renovation rates to rise to almost 3% (from 1%)**. This means that in 2030, **the renovation market would be worth about EUR 122 billion** with approximately **988,200 additional jobs** in the sector.[40] **GHG emissions would fall by 62.9% in the residential sector and 73% in the non-residential sector** by 2030. With a 27% target, by 2030 **GHG emissions would fall by 33.8% in the residential sector and 50.6% in the non-residential sector**.

2.3. Costs of building renovations

The investment required to renovate Europe's building stock has been estimated to be of the order of EUR 1 trillion.[41] Estimates of energy renovation costs range from EUR 200 to 450 per m^2 depending on the depth of renovation.[42] Focusing less on energy efficiency and more on renewable energy supply (as an alternative to deep renovation) turns out to be 3.5 % more expensive.[43] Figure 6 shows that the costs of renovation differ per country, with labour costs likely to be a key factor in this variation.

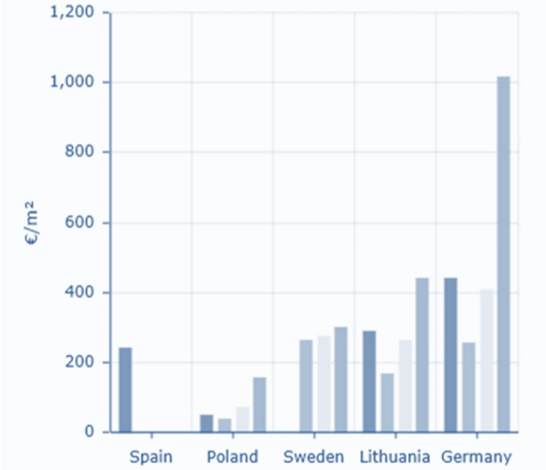
Figure 6: Average investment cost for different depths of renovation of residential buildings per m² in 2005



Source: ZEBRA2020 Data tool

[37] Ecofys, 2015. The role of energy efficient buildings in the EUs future power system.
[38] http://cordis.europa.eu/result/rcn/155671_en.html.
[39] Eurima, 2012. Renovation tracks for Europe up to 2050; building renovation in Europe - what are the choices?
[40] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.
[41] IEA, 2014. Special Report: World Energy Investment Outlook.
[42] JRC, 2015. Energy renovation: The Trump Card for the New Start of Europe.
[43] Ecofys, 2012. Renovation tracks for Europe up to 2050.

Figure 7: Average investment cost for different depths of renovation of non-residential buildings per m² in 2005



Source: ZEBRA2020 Data tool

The overall costs assocated with building renovation are split between the property owners, public authorities and tenants (for rented or leased buildings) as explained below. Further detail is given in Annex A.

Figure 8: Costs of renovation for different actors

Costs and burdens for property owners and landlords	Costs and burdens for authorities	Costs and burdens for tenants
•Assessment costs •Installation costs •Financing costs •Hidden costs •Costs of understanding regulations	•Set up costs •Implementing, administrating, monitoring costs •Other costs e.g. advising on regulations	•Potential rent increases

2.4. Benefits of renovation

Building renovations have several benefits in addition to energy savings. The diagram below shows the most relevant ones. Further detail is given in Annex B.

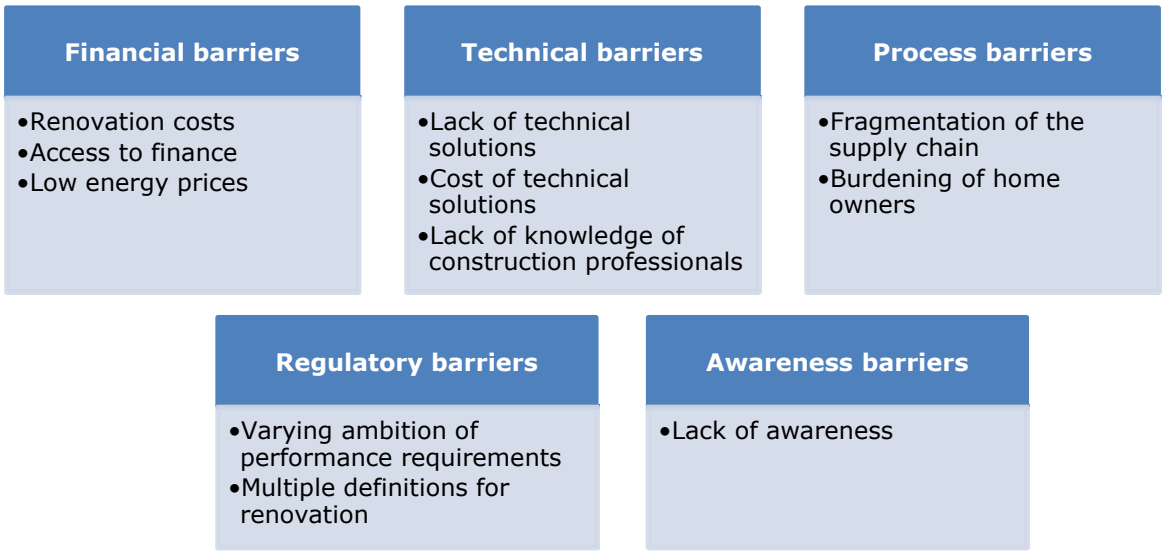
Figure 9: Benefits of renovation

Environmental benefits	Economic benefits	Social benefits
•Energy savings & GHG emissions reduction •Reduced usage of materials	•Employment •GDP and public budgets •Innovation •Sectoral modernisation •Energy Security •Productivity benefits	•Health benefits •Reduction energy poverty •Wellbeing / Comfort benefits •Energy bill savings •Increase in property value & tenant satisfaction

2.5. Barriers to renovation in the EU

Figure 10 illustrates the key barriers to renovation. Further detail is given in Annex C.

Figure 10: Key barriers to energy renovation of buildings



3. POLICIES TO BOOST RENOVATION

3.1. Overview of current policies to boost building renovation

3.1.1. EU targets and strategies

In 2008, the European Commission adopted the 2020 Climate and Energy Package, which established a target for a 20% improvement in EU's energy efficiency by 2020. The 2030 Climate and Energy Framework[44], set an additional target of at least 27 % energy savings compared to baseline projections by 2030.

The 2011 Roadmap to a Resource Efficient Europe (RERM)[45] highlights buildings as one of three key sectors to be addressed to make significant resource savings. It includes the following milestones: b*y 2020 the renovation and construction of buildings and infrastructure will be made to high resource efficiency levels (…) policies for renovating the existing building stock will be in place so that it is cost-efficiently refurbished at a rate of 2% per year.*

3.1.2. EU policies

The Energy Performance of Buildings Directive (EPBD)[46], together with the Energy Efficiency Directive (EED)[47], the Renewable Energy Directive (RED)[48] , the Ecodesign Directive[49] and Energy Labelling are the key pieces of EU legislation relating to long-term improvements in the energy performance of Europe's building stock.

Energy Performance of Buildings Directive (EPBD)

Article 7 of the 2010 EPBD recast addresses renovation. The Directive intends to encourage renovation requiring MSs to draw up national plans for increasing the number of nearly zero-energy buildings (NZEBs)[50] including a list of national measures for funding energy efficiency renovations.[51] The recast also required that existing buildings undergoing major renovation[52] meet minimum energy performance requirements[53] in so far as this is technically, functionally and economically feasible. The EPBD further suggests that public buildings "set an example" by being subject to regular energy certification, and displaying their energy performance certificates (EPCs) in a prominent place.

Energy Efficiency Directive (EED)

Article 4 of the EED requires each MS to establish a lon-term strategy or roadmap for mobilising investment in the energy efficient renovation of the national stock of residential and commercial buildings, both public and private. As such, EU countries must create an overview of their national building stock, identify cost-effective ways to renovate according to building type and climate, create policies and measures to stimulate investment in energy

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44 COM (2014) 15. A policy framework for climate and energy in the period from 2020 to 2030.

45 COM (2011) 57EC. Roadmap to a Resource Efficient Europe.

46 Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

47 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency.

48 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources.

49 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products.

50 EPBD Recast, 2010. Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (EPBD).

51 https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings/financing-renovations.

52 Member States should be able to choose to define a 'major renovation' either in terms of a percentage of the surface of the building envelope or in terms of the value of the building.

53 The method for the calculation of this is laid out in annex I of the EPBD recast.

efficient building renovation and create estimates of expected energy savings. Annex D contains a summary of the targets included in these national strategies.

The EED requires an annual renovation rate of 3% of buildings owned and occupied by national central governments.[54] It also requires MSs (Article 7) to establish and operate Energy Efficiency Obligation Schemes (EEOS) or Alternative Measures (e.g. taxes, financial incentives, regulations, voluntary agreements or labelling, training, education and advice) that achieve the same amount of energy savings. Schemes are currently in place in eleven MSs (Austria, Bulgaria, Denmark, France, Italy, Ireland, Luxembourg, Poland, Slovenia, Spain and The UK) with good evidence of cost-effective savings, and a further five MSs plan to establish such schemes. In six MSs (Denmark, France, Ireland, Italy, Poland and The UK), EEOS have transitioned from voluntary to mandatory.[55] It is not clear if the use of Alternative Measures is positive or negative and their effectiveness relative to EEOS will be hard to assess because of the wide range of other factors that influence building renovation rates and depths.

As part of their National Energy Efficiency Action Plans (NEEAPS), EU countries have drawn up national long-term strategies to show how they plan to foster investment in the renovation of residential and commercial buildings. According to recent research from the Joint Research Centre (JRC), the submitted strategies are on track when it comes to meeting the requirements of Article 4 of the Energy Efficiency Directive (EED). 74% of national strategies meet the requirements of EED. Ten countries show 'exemplary' standards namely the Czech Republic, France, Greece, Hungary, Ireland, Lithuania, Romania, Slovenia, Spain and the UK. Six MSs are 'not compliant' (i.e. their renovation strategies can be considered insufficient) namely Austria, Bulgaria, Poland, Portugal and the Wallonia and Flanders regions of Belgium – although this may be due to a reporting issue.[56]

Ecodesign and Energy Labelling Directives

The Ecodesign Directive (2009/125/EC)[57] sets minimum efficiency standards for technologies used in the building sector (e.g. boilers, hot water generators, pumps, ventilation, lighting, etc.). The Energy Labelling Directive[58], obliges MSs to use energy efficiency labelling schemes for a number of products used in the building sector.

Renewable Energy Directive (RED)

The Renewable Energy Directive (RED)[59] focusses on achieving EU and national targets for the use of energy derived from renewable sources. Building integrated renewables (PV, solar thermal, biomass boilers, etc.) are clearly noted as having a role in achiveing these targets, but there is nothing specifically related to the energy efficient renovation of buildings.

Roadmap for the Energy Union

Buildings are a pillar of the Energy Union as set by the 2015 Communication 'A Framework Strategy for a Resilient Energy Union with a Forward-looking Climate Change Policy'l[60], which

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[54] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency.

[55] CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).

[56] Castellazzi L., Zangheri P., Paci D., 2016. Synthesis Report on the assessment of Member States' building renovation strategies.

[57] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products.

[58] Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances.

[59] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources.

[60] COM (2015) 080 final. A Framework Strategy for a Resilient Energy Union with a Froward-Looking Climate Change Policy.

calls also for action in this regard through the so-called 'Smart Financing for Smart Buildings' initiative to make existing buildings more energy efficient, facilitating access to existing funding instruments.

Overview of key policies and instruments

✓ - It addresses this barrier to a certain extent

✓✓ - It addresses this barrier to a great extent

X – I does not address this barrier

Table 1: EU building renovation policies classification according to barriers addressed

Policies/Barriers	Financial barriers	Technical barriers	Process barriers	Regulatory barriers	Awareness barriers
EPBD	✓✓	✓✓	✓	✓ Detailed building regulations are delegated, but this sets limits, which should help achieve a minimum cosistency	✓ Exemplary public sector + Building stock observatory
EED	✓	✓	X	✓ Some MSs have adjusted regulations as a result	✓ Exemplary public sector
RED	✓ (indirectly, as MSs have RES support tarrifs to help meet the targets)	X	X	X	✓ Exemplary public sector
Ecodesign & Energy Labelling Directive	X	✓ Ecodesign	X	X	✓✓ Energy labelling
EU funds	✓✓ ERDF, Cohesion Fund, H2020, IEE, etc. providing grants and/or FIs	✓ Build up skills (was part of IEE, now H2020)	X	X	X

Policies/Barriers	Financial barriers	Technical barriers	Process barriers	Regulatory barriers	Awareness barriers
Roadmap for the Energy Union	√√ Smart Financing for Smart Buildings	X	X	X	X

Source: Trinomics

3.1.3. EU financial tools

Over EUR 38 billion is available over the period 2014-2020 from EU sources (e.g. Cohesion Fund, ERDF, H2020) to support the shift to a low carbon economy, with one third of this total of potential relevance to boosting energy efficiency in buildings.[61] Leveraging public and private sources, there is a potential to mobilise investment through financial instruments in excess of EUR 100 billion over 2014-2020.[62] The decision to specifically target structural funds on the energy efficient refurbishment and the use of renewable energy in existing homes began with a change to the regualtions in 2009, as part of the European Economic Recovery Plan. The change allowed up to four per cent of each member state's ERDF allocation (including Eastern MSs with large stocks of low efficiency housing) to be spent on this. The success of this change in improving the energy efficiency of existing housing stock quickly became apparent[63]. This approach was continued and expended in the 2014-2020 fuding period, with the requirement that 12% to 20% (depending on the region's level of development) of each region's European Regional Development Fund (ERDF) allocation should be invested in measures supporting the shift to a low-carbon economy. DG Regio produced technical guidance[64] to Member States on 'Financing the energy renovation of buildings with Cohesion Polcy funding' which includes advice on the use of financial instruments to leverage EU funds.

A report from the Energy Efficiency Financial Institutions Group (EEFIG) describes a number of financial instruments relevant for renovation[65], these include: Dedicated credit lines (or soft loans); risk-sharing facilities (Guarantee funds and First-loss Facilities); real estate and infrastructure funds; and Energy Performance Contracts. The EEFIG also identifies other emerging instruments. These include: On-Bill Repayment, a mechanism used to improve the creditworthiness (or seniority) of energy efficiency investments by having them repaid in the utility or tax bill and through the existing payment collection infrastructures of utilities or public authorities; and green bonds for green buildings (Supply Driver) led by the private sector and institutional investors. The European Commission have announced[66] that they will present a new Smart Financing for Smart Building initiative in the autumn of 2016.

3.1.4. National policies

Each MS has its own regulations, in line with the EPBD and EED, regarding buildings and renovation. Analysis of the MS policies reported as being designed to meet national and EU

[61] CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).

[62] CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).

[63] http://www.buildup.eu/sites/default/files/content/housing_structural_funds_web.pdf.

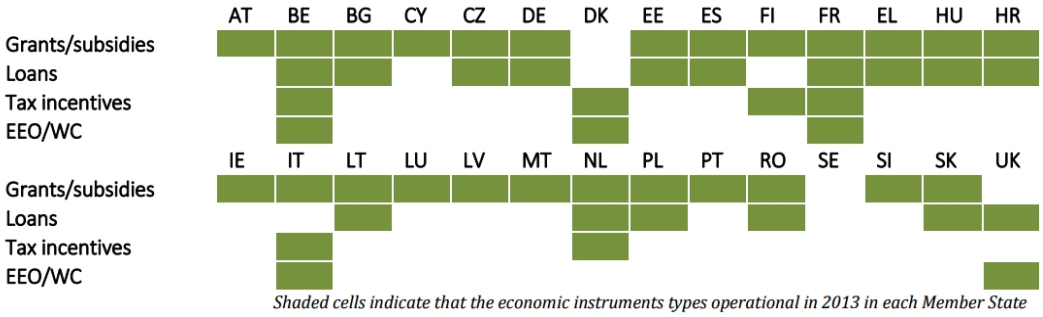
[64] https://ec.europa.eu/energy/sites/ener/files/documents/2014_guidance_energy_renovation_buildings.pdf.

[65] EEFIG, 2015. Energy efficiency, the first fuel for the EU economy. How to drive new finance for energy-efficiency investments. Part 1: Buildings (Interim Report).

[66] http://www.euractiv.com/section/climate-environment/news/energy-union-boss-wants-wave-of-public-finance-to-spur-building-renovations/

energy and renovation targets indicates that 43% are financial and fiscal measures – of which 90% are grants; 25% are regulatory measures - mostly directed to the implementation of the EPBD provisions regarding new buildings (and not renovations); and 13% are measures addressing issues such as training and capacity building. Of the planned measures, 36% are related to financing and 35% to regulatory measures.[67] The table below provides a country overview regarding existing economic instruments targeting energy renovations.

Table 2: Main economic instruments in 2013 targeting energy renovations



Note: EEO – Energy efficiency obligation; WC – White certificate

Source: JRC, 2014. Financing building energy renovations: current experiences & ways forward

Annex E illustrates a selection of Member State specific regulation and policy measures.

[67] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

4. ASSESSMENT OF POLICY OPTIONS

This chapter describes and assesses the potential impacts associated with various policy options, providing a qualitative (and in parts quantitative) assessment of their costs and benefits. These policy options are intended to suggest ways in which the EU and MS governments can help overcome the main barriers to the energy efficient renovation of buildings.

4.1. Definition of policy options

There are a wide range of voluntary and mandatory (policy) initiatives or schemes that are designed to stimulate the energy efficient renovation of buildings in the EU. The table below categorises some of the key policies.

Table 3: Categorisation of policy measures to boost building renovation

Type	Examples of policy option
Regulatory	• Mandatory building codes • Minimum Energy Performance Standards (MEPS) • Refurbishment obligations • Energy Efficiency Obligation Schemes (EEOS)
Financial and fiscal	• Subsidies and financial instruments • Grants for research, development and innovation (RDI) programmes (e.g. for nZEBs & smart meter roll-out) • Tax incentives • Energy Service Company (ESCO)
Information campaigns & Labelling	• Awareness raising and information campaigns • EU Energy Performance Certification (EPCs) • (Voluntary) energy labelling schemes • EU ecodesign and energy labelling
Others	• Voluntary and negotiated agreements • Energy audits • Skills development and capacity building programmes

Source: Adapted from Castellazzi L., Zangheri P., Paci D., 2016. Synthesis Report on the assessment of Member States' building renovation strategies

4.1.1. Regulatory measures

Mandatory building codes and Minimum Energy Performance Standards (MEPS)

Building codes specify standards regarding the construction, renovation and occupancy of buildings to protect public health, safety and general welfare. They may include energy efficiency / thermal standards or renovations as part of their scope. The Building Code in each MS is required to be in line with the EPBD.

Mandatory MEPS– unlike building codes whose scope covers a wide range of provisions – would only focus on setting energy requirements for buildings. All buildings under the scope of the MEPS would have to meet a basic energy efficiency standard within a given framework. An alternative would be to make this voluntary or mandatory only for certain, e.g. public buildings. The standard could be designed especially for this purpose, or an existing standard could be adopted (e.g. BREEAM or LEED), or the energy labels (known as Energy Perfromance

Certificates (EPCs)) that buildings are required to show when sold (or rented in many MSs) could be used. There are several examples of building codes and MEPS, such as Germany's minimum energy performance standards for buildings (Energieeinsparverordnung - EnEV – or Energy Saving Ordinance in English). The requirement to reach a mimimum energy standard could be triggered when the building is sold, rented or renovated.

Table 4: Pros and cons of building codes and MEPS

Pros	Cons
• Directly relate to individual buildings • Complementary to ecodesign of appliances and equipment • Building codes present in all countries, would only require adaptation • Effective, would address the issue directly since it's mandatory • A MEPS operation framework could build-on existing EPC framework • Take up can be high when paired with financial incentives • Can be paired with other standards such as sanitation and safety	• Address only new buildings and major renovations (or at sale/ rental) • Problem with enforcement, decreases their effectiveness • The results would depend on the stringency of the minimum requirements • Difficult to gain political acceptance if they are mandatory • MEPS needs operational framework (setting the standard, accredited auditors, etc.) • Needs a long compliance period to gain support, potentially delaying results

Source: Trinomics

Annex E includes a description of the UK's policy to require landlords to renovate their properties to a minimum energy standard before they can be rented out (or when the tenant changes).

Refurbishment obligations

The EED requirement for Member States to renovate 3% per year of the total floor area of buildings owned and occupied by the central government only affects a small proportion of Europe's buildings.[68] However, a similar obligation could be set for additional building types (e.g. buildings in the service sector or social housing) and/or the obligation could be expanded to include buildings owned and occupied by regional and local governments.

Table 5: Pros and cons of refurbishment obligations

Pros	Cons
• Targets all existing buildings (or selected segment of existing building stock) • Approach being used for public buildings could be expanded • Can be combined with existing EPCs	• Needs appropriate monitoring • Burden on building owners • Needs to be combined with incentives • Although some MSs do it on a voluntary basis, the EED does not require the reporting of projected energy savings from the buildings stock

Source: Trinomics

Energy Efficiency Obligation Schemes (EEOS)

EEOS are a policy mechanism that obliges energy suppliers to fund energy savings amongst their customers, with the amount of energy that needs to be saved typically defined on a per customer basis. EEOS can deliver highly cost effective energy savings. Most EEOS cover all

[68] BPIE, 2015. Renovation in practice. Best practice examples of voluntary and mandatory initiatives across Europe.

sectors, but some focus mainly, or exclusively, on the residential sector. As would be expected, the majority of measures funded by EEOS are 'low-hanging fruits' (i.e. investments with the largest energy saving per unit of expenditure), in the residential sector this typically means efficient light bulbs and roof insulation. For EEOS focused on buildings, continuing to deliver highly cost-effective savings becomes more challenging over time, as the opportunities available to install low-cost, mass market, technological savings opportunities are gradually used up. Therefore, rather than targeting low-income or fuel poor households, EEOS should focus on housing with very low energy efficiency standards. EEOS need to be combined with other policy measures, such as publicly funded grants and subsidised loan programmes.

Table 6: Pros and cons of EEOS

Pros	Cons
• In place or planned in 16 MSs[69] • Effective in housing with very low EE standards • Targets the most cost effective savings first	• Different design in different MS • Risk of under delivery for countries with new EEOS which have not taken steps to shorten the learning period (i.e. BG, HR, EE, LV, LT, ES)

Source: Trinomics

Annex E includes an example of the Danish EEOS, which has operated since the 1990s and has overachieved its annual energy saving target in every year except one. The Annex also describes the Spanish approach where an EEOS equivalent is combined with Structural Funds to finance domestic energy efficiciency investments.

4.1.2. Financial and fiscal measures

Subsidies and other financial instruments

An example of such an instrument is financial support for households (and/or building owners) that fulfil certain energy performance standards/ improvements when renovating their building. The financial support is to help purchase and install energy efficiency measures/ equipment. This support can come from a dedicated fund, with a body established that can also provide support regarding information on other possible financial instruments (e.g. tax advantages, soft loans, grants, etc.). It can target particular types of the housing stock and could further target, for example, low-income households to address energy poverty. An example of such a programme is the French Habiter Mieux programme and the German Reconstruction Credit Institute's (KfW) programmes (which are described in Annex E). An implementation risk is the attraction of recipients who would have carried out the investments without the incentive (i.e. free riders). In order to reduce this risk, careful design is required, e.g. restricting the scope to those least able to finance the investments themselves e.g. low income households and Small and Medium Enterprises (SMEs).[70]

Annex E includes a profile of the Slovakian Municipal Sustainable Energy Financing Facility (MunSEFF) facility financed by the European Bank for Reconstruction and Development (EBRD) and the EC, which supported energy efficiency schemes via ESCOs and other methods in 114 municipal buildings and 219 residential buildings. The Annex also includes a description of a grant programme in Brussels to support exemplary energy renovations and to support energy surveys.

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[69] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

[70] JRC, 2014. Financing building energy renovations: current experiences & ways forward.

Table 7: Pros and cons of subsidies and other financial instruments

Pros	Cons
• Can be effective, has been used broadly • Can target low income households • Targets existing buildings • Could be complemented by an information and marketing option. • Grants and rebates most effective.	• Needs a budget and an administrative body • Risk of not enough participation & of free riders • Eligibility criteria need to be properly designed and checked (avoiding misuse of this instrument) • Might need co-financing from tenants/ landlords, which can be challenging for some tenants/ owners • Monetary incentives are helpful but not sufficient to overcome the barriers for rental housing. Non-financial incentives also play a major role (marketing is needed)

Source: Trinomics

Grants supporting RDI programmes (e.g. for nZEBs and smart meter roll-out)

Funds are available at EU and national level to support research, development and innovation. At the EU level, for example, the Horizon 2020[71] programme includes support for technology designed to improve the energy efficiency of buildings.

Table 8: Pros and cons of RDI Grants

Pros	Cons
• Can be targeted on those issues with key known technical and/or cost constraints • Supports innovation and the knowledge economy – with future growth and jobs benefits	• Inevitable delay between developing and commercialising the solutions • Resistance to change in the construction sector slows uptake of innovation

Tax incentives

There are a number of ways in which the tax system can be used to encourage the energy efficient renovation of buildings. This can be done by purchase tax (e.g. VAT) reductions for specific products that are key to energy efficient renovation, such as boilers, water heaters, PV systems, double glazing, insulation, etc. It can also be done through income tax incentives based on the renovation investment as a whole. In this case a maximum renovation expenditure allowance (in Euros/building) can be set against earnings to reduce the taxable amount and hence reduce the tax bill of the household / building owner. Examples of such fiscal schemes are available in Italy, France and Belgium and are described in Annex E. Tax

[71] Horizon 2020, through its Secure, Clean and Efficient Energy Challenge, includes both "Energy Efficiency" and "Smart Cities and Communities" as focus areas. 2016 calls for proposals include E-11: Overcoming market barriers and promoting deep renovation of buildings. Projects include, REFURB (REgional process innovations FOR Building renovation packages opening markets to zero energy renovations), PROF-TRAC (PROFessional multi-disciplinary TRAining and Continuing development in skills for nZEB principles), and URBAN RECREATION (Energy efficient retrofit for carbon zero and socio-oriented urban environments). Intelligent Energy Europe (now part of H2020) also financed relevant projects such as PassREg (Passive House Regions with Renewable Energies), Nearly Zero-Energy Building Strategy 2020 (ZEBRA2020) and Promotion of smart and integrated nZEB renovation measures in the European renovation market (NEZER).

deductions can also be applied to property taxes. For example, one off, or ongoing property tax discounts can be offered for buildings which have been renovated to a high standard of energy efficiency.

Table 9: Pros and cons of tax incentives

Pros	Cons
• Widely used (not to the extent of grants) • Applicable to renovations and to products • Mobilises private funding • Does not affect the producer	• Free riders • Less tax income – cost for government • Administrative costs

Source: Trinomics

Energy Service Companies (ESCOs)

The ESCO concept is intuitively attractive because it uses the money saved through investments in energy efficiency to pay off the cost of the initial capital investment. The customer pays an "energy services charge," which allows the ESCO to collect the funds each month from customers. With the ESCO using this charge to both purchase the (reduced) amount of energy required and to repay the capital invested in energy efficiency. An innovative feature (known in the United States as Pay-As-You-Save (PAYS)) is that the charge is assigned to the meter location, thereby associating the costs and the savings to the person paying the energy bill, rather than the costs of installation going to the owner of the property (as they are not necessarily the same person) and the energy savings benefitting the occupier. This approach can help overcome the split incentive (also known as the landlord/tenant) barrier.

Table 10: Pros and cons of ESCOs

Pros	Cons
• Provides financing for any and all energy efficiency products, purchased with no money down and financed by the utility or an independent provider	• Not widely implemented as it represents a departure from the current system • Major regulatory action would be required to allow tariffs to be assigned to meters rather than to customers (as the building user may currently change their energy supplier at will, but for an ESCO arrangement to work, the tariff needs to stay in place until the ESCO recovers the cost of their expenditure on improving energy efficiency)

Source: Trinomics

Energy audit programmes

Energy audit programmes can be supported by governments at different levels. The purpose of energy audits is to assess the energy use of the building, to determine the energy savings potential and to present recommendations on profitable energy saving measures. Energy audit programmes usually combine financial incentives (subsidising the audits themselves) with information regarding potential energy saving measures. Annex E includes a description of a Finnish energy audit programme, which has covered over 40% of the building stock since it started in 1992 and audited all of the industrial energy use.

Table 11: Pros and cons of energy audit programmes

Pros	Cons
• Can be very effective, especially for services and non-intensive industry • Additional aspects can be included in the scope (e.g. processes, material and water use)	• Active promotion is essential • Audit is broader than only renovation • Needs to include: development of energy audit models, auditor's tools, training and authorisation of auditors, monitoring and quality control • Does not ensure implementation of suggested measures (unless e.g. combined with financial incentives that require this)

Source: Trinomics

4.1.3. Information campaigns & labelling

Awareness raising and information campaigns targeted at consumers and industry

This is a relatively "light" approach, in that it is low cost in comparison to policies such as tax incentives and audits. It is intended to increase awareness and increase the demand for more energy efficient buildings. The information on the benefits of energy efficiency and the ways in which it can be improved can be provided by any level of government, independent organisations or local groups.

Table 12: Pros and cons of information campaigns

Pros	Cons
• Very light approach, easily politically acceptable • Moral or "soft" incentives such as information provision and community-based social marketing campaigns appeal to individuals' sense of reason and responsibility in order to encourage efficiency investments • Improves relationship between landlords and tenants (e.g. via forums, communication) • They can make informed decisions about energy usage and living situation	• Effectiveness and efficiency are hard to evidence because it is very difficult to isolate, demonstrate or prove the direct influence of such schemes

Source: Trinomics

EU Energy Performance Certification (EPCs)

The EPBD, among other measures, introduced a framework for energy performance certificates (EPCs), although some MSs had similar sytems prior to this. EPCs cover residential and non-residential buildings, whether they are public or private, owner-occupied or rented.[72] The main costs of EPCs are the costs to the bulding owner of getting a survey. There are also some costs associated with administering the system of accrediting surveyors and mainting a register of certificates. EPCs must include reference values in order to make it possible for consumers to compare and assess energy performance. They must also be

[72] DG ENER, 2013. Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries.

accompanied by recommendations for cost-effective improvement options to raise the performance and rating of the building. The EPC performance must be published at the time of advertising a building for sale or rental, and provided when signing a purchase agreement or rental contract.

Table 13: Pros and cons of EPCs

Pros	Cons
• EPCs provide information for consumers and authorities – based on the belief that this boosts the demand for buildings that perform better in terms of energy-efficiency	• Some feel that EPCs are still too technical and complex for consumers to understand[73] • Public acceptance and market uptake have been identified as challenges for EPCs.[74] For example, banks will not grant a loan for renovation based on an EPC[75]. • Insufficient implementation and enforcement by Member States and consequent lack of usefulness and credibility across the EU[76]

Source: Trinomics

Voluntary energy labelling schemes

There are several energy labelling or certification schemes for buildings, with some of the best known being BREEAM, LEED, HQE and Passivhaus. The approach is to have a label / certification that shows the energy performance of the building (though most of the schemes cover other environmental issues as well). This is intended to create an incentive for buyers and/or owners on the assumption that more energy efficient buildings are worth more, because they are cheaper to run and because the fact that they are labelled as more efficient increases their prestige for those wishing to publicise their environmental credentials.

Table 14: Pros and cons of voluntary energy labelling

Pros	Cons
• Voluntary, less opposition to implement • Could be linked to the existing EPCs • Relatively cheap to obtain the certificate for residential housing • A number of schemes already in place	• Lower uptake since it's voluntary • Only the best performers are likely to get the label • Only a small share of buildings is likely to get labels • Mostly for new buildings, existing buildings are more difficult to label, most would get a low rating

Source: Trinomics

EU ecodesign and energy labelling

Ecodesign can be regarded as 'choice editing' in that it makes it harder (or impossible) to buy energy using appliances with lower standards of energy efficiency. Energy labelling is intended to stimulate buyers to purchase the most efficient appliance / equipment as a result

[73] CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).
[74] BPIE, 2014. Energy Performance Certificates Across the EU.
[75] CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).
[76] BPIE, 2014. Energy Performance Certificates Across the EU.

of standardised and comparable information on energy efficiency (and other factors) being clearly available at the point of sale.

Table 15: Pros and cons of ecodesign and energy labelling

Pros	Cons
• Already in place for several key types of appliance and equipment (e.g. Ecodesign and energy labelling directives) • Known to be effective	• Not sufficient to solve the issue alone as they do not cover all potential sources of energy efficiency • Do not cover the energy performance of the building as a whole

Source: Trinomics

4.1.4. Others

Voluntary and negotiated agreements

An example of a voluntary agreement would be a covenant where a housing association agrees to renovate their properties to reach a specific energy performance (e.g. energy label B) within a specific timeframe. This example requires a structured and regulated rental market. Annex E includes a description of a Dutch example of this type of covenant, where a housing corporation has committed to improving the efficiency of their housing stock.

Table 16: Pros and cons of voluntary agreements

Pros	Cons
• Take up can be high when paired with financial incentives • Voluntary, so less opposition to implement • Involvement and ownership from key stakeholders (housing associations)	• Need a commericalised, top-down market (associations) • Level of ambition depends on the housing association

Source: Trinomics

Skills development and capacity building programmes

An example of a relevant skills development and capacity building programme is the BUILD UP skills programme[77]. This was initiated in 2011 to boost continuing and further education and training of craftsmen and other on-site construction workers, and (energy efficiency and renewable energy) systems installers in the building sector. It is managed by the European Commission's Executive Agency for Small and Medium-sized Enterprises (EASME). It began as part of the Intelligent Energy Europe (IEE) programme and is now contuing as part of the Horizon 2020 programme. BUILD UP skills offers financial support to national teams to foster the continued education of workers in the building sector. The initiative stemmed from the shortage of building workers expected by 2020 in most European countries and the need for training of the current workforce to be able to construct according to energy efficiency standards and to install renewable energy technologies. It was estimated that up to 3 million workers were in need of up-skilling on energy efficiency and/or renewable energy technologies by 2020.[78] To date, no cost-effectiveness assessment of the initiative has been

[77] http://www.buildupskills.eu/about-bus.

[78] Vincent Berruto, 2015. Introduction to the 7th BUILD UP Skills EU-exchange meeting. Presentation at the BUILD UP Skills 7th EU Exchange Meeting in Brussels, Belgium.

performed. This can be expected from the final evaluation of the programme after Pillar II is completed.[79]

Table 17: Pros and cons of skills development and capacity building programmes

Pros	Cons
• The complexity of energy-efficient renovation and the current skills gap makes the need for training key • Brings many stakeholders together, such as national energy agencies, government or ministries; organisations for vocational training and education, associations of workers (e.g. electricians, insulation workers, workers with construction skills, plumbing, heating installations, carpenters, installers etc.) and financial institutions[80]	• Preparing the Calls for Proposals for BUILD UP Skills was a time-consuming process due to consultation processes with professional organisations and the need to prepare pre-filled templates to ensure comparability of the applications • BUILD UP Skills targeted blue-collar workers, but the evaluation of the first pillar of the programme (Pillar I) concluded that there is also a need to train white-collar workers (e.g. architects and engineers)[81]

Source: Trinomics

[79] Trinomics is supporting EASME with the evaluation of Pillar II of BUILD UP Skills, which is due summer 2017.
[80] EC, 2016. Evaluation of the BUILD UP Skills Initiative under the Intelligent Energy Europe Programme.
[81] EC, 2016. Evaluation of the BUILD UP Skills Initiative under the Intelligent Energy Europe Programme.

4.2. Assessment of the economic, social and environmental impacts of the different types of policies

Table 18: Assessment of policy options

Policy	Type	Barriers addressed	Scope	Costs	Benefits	Other
Building codes and MEPS	Regulatory	Regulatory	All buildings	High (due to operational framework needed)	High potential (Mandatory, but depends on requirements' stringency)	Long compliance period Enforcement issues
Refurbishment obligations	Regulatory	Regulatory	Existing buildings	Medium (depends on monitoring scheme)	High potential (Mandatory, but depends on goal's stringency)	Long compliance period Enforcement issues
EEOS	Regulatory	Financial	All buildings (and energy use)	Medium (majority of cost is borne by utilities, but this is likely to ultimately be passed onto consumers)	High, but likely to dimish over time. Not good for 'deep renovation'	Utilities are likely to pick most cost effective measures first.
Subsidies & other FIs	Financial	Financial	All buildings	High 185.2 €/GJ (Germany KfW loans & grants) 99.3 €/GJ (Belgian grants)	Medium	Risk of free riders FIs are preferable, could use a revolving fund to limit costs
Grants for RDI programmes	Financial + Informative	Technical / Awareness	Industry + Demonstration projects	Low	Limited	Speed of take up of innovations often limited by the conservative nature of the construction sector
Tax incentives	Fiscal	Financial	All buildings	High 111.8 €/GJ (Italian tax credit) 460.9 €/GJ (French tax credit)	Medium	Risk of free riders

Policy	Type	Barriers addressed	Scope	Costs	Benefits	Other
ESCOs	Financial	Financial / Process	All buildings	Low	Medium	Can be constrained by freedom of energy supplier legislation -as it requires the energy customer to stay with a supplier for a fixed term
Energy audits	Financial + Informative	Technical / Awareness	All buildings	Low 0.09-0.11 €/GJ (Finland)	Medium	Risk of measures not being implemented
Awareness & information campaigns	Informative	Awareness	Tenants, owners, industry	Low	Limited	Hard to prove / isolate the impacts
Voluntary energy labels	Informative	Awareness	All buildings	Low	Limited	Several labels already in place
EU ecodesign and energy labelling	Regulatory + Informative	Awareness	Appliances & equipment			
Voluntary agreements	Other	Process	Buildings from housing associations	Low	Medium (depends on goal's stringency)	Need commercialised market
Skills and capacity building	Informative	Technical / Awareness	Industry	Medium	Medium	

Costs: Costs to the EU and MSs incurred by the need to implement and monitor the policy option.

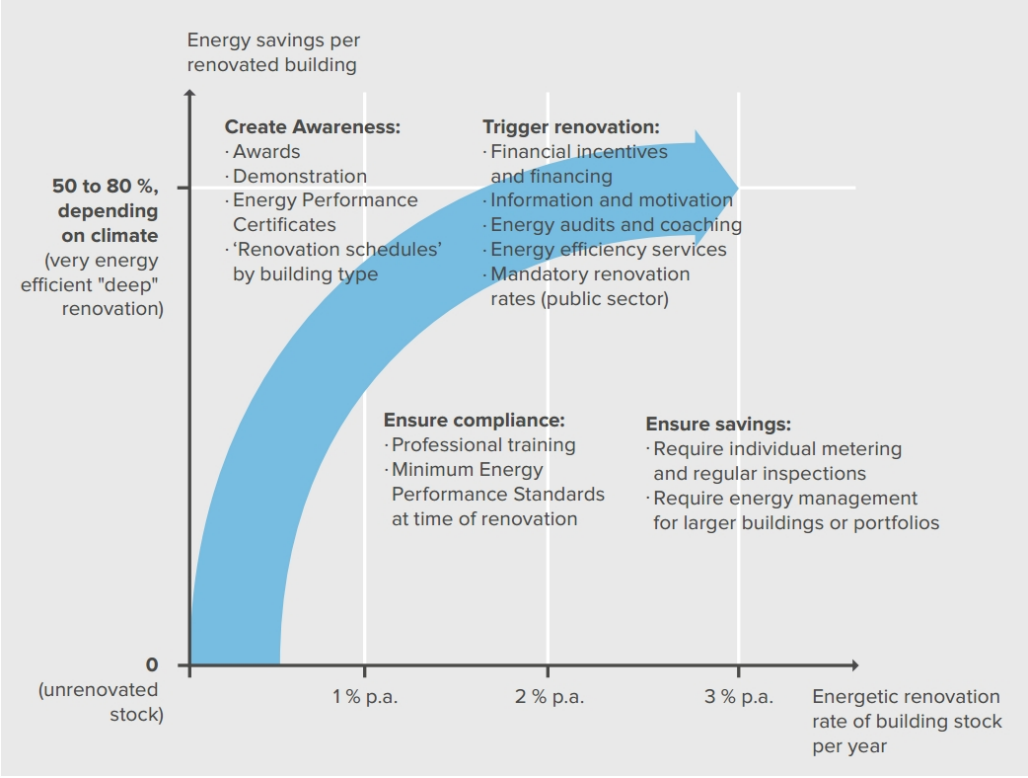
Benefits: Increase in building renovations expected as a result from the policy option.

Source: Trinomics

4.3. Interactions between policies

It is hard to arrive at a definition of an "optimal mix of policies" although it is apparent that combining different types of policies in a package, is likely to be more effective than stand-alone measures. According to a JRC study, 60% of economic instruments addressing energy retrofits were reported to be part of a policy package (though what constitutes a policy package is not consistently defined across MSs).[82] The different policy options presented above interact in several ways. Synergies can and should be created, but the interactions should be considered to avoid instruments undermining each other's objectives and credibility. The figure below provides an overview of the most relevant policy effects, and how several measures together can provide better results, by both increasing the level of energy performance of the buildings and the amount of buildings being renovated.

Figure 11: The interactions of policy instruments for energy efficiency in building renovation and operation



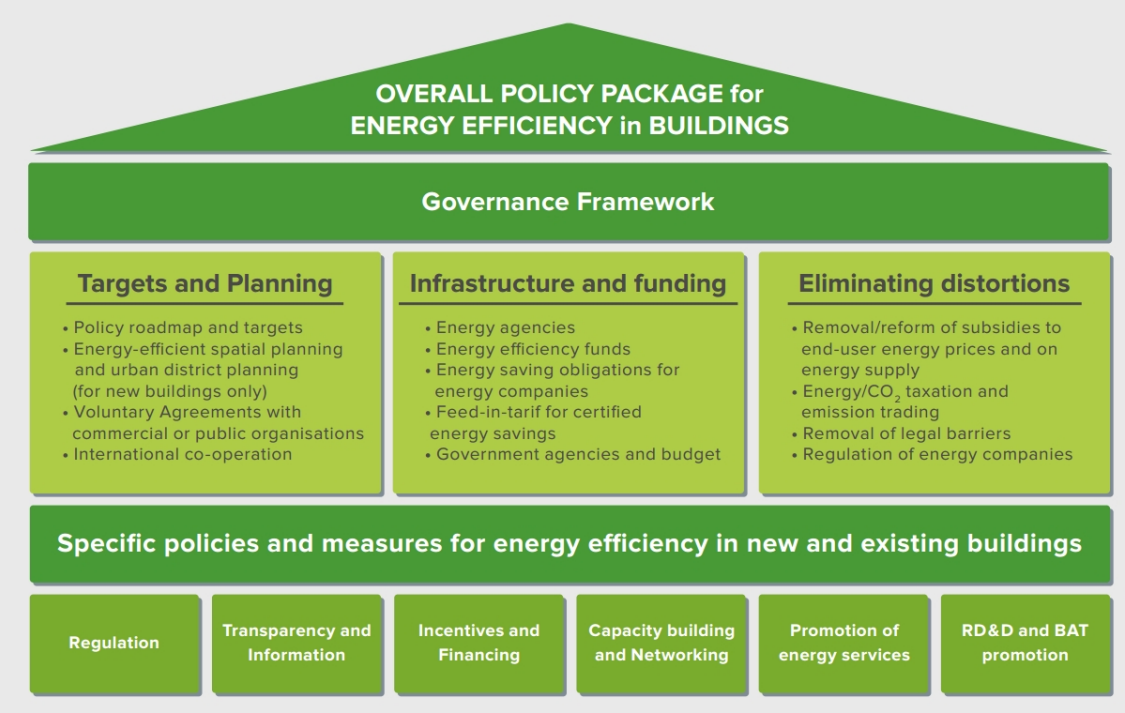
Source: Wuppertal Institute (2015), Energy efficiency policies for buildings

According to a Wuppertal study, the operational goal for a policy package aimed at building renovation should be to: 1) achieve "deep" energy retrofits when a building is renovated; and 2) increase the rate of "deep" renovations[83]. The Wuppertal study includes the following table which provides a breakdown of the various policy types needed in a policy package:

[82] JRC, 2014. Financing building energy renovations: current experiences & ways forward.

[83] Wuppertal Institute, 2015. Energy efficiency policies for buildings.

Figure 12: Components of the recommended policy package for energy efficiency in buildings



Source: Wuppertal Institute, 2015. Energy efficiency policies for buildings

Mandatory MEPS are arguably the most important instrument for new buildings, and also very important for renovations. However, for existing buildings, research suggests that the most important policies are those tackling information and financial barriers.[84] These instruments include EPCs and energy labels combined with awareness raising programmes and individual advice for building owners (e.g. energy audits), as well as financial support for investors[85]. EPCs have a number of interactions with other policies. A specific (relatively high) EPC rating is often used as a target for other interventions such as financial support or refurbishment obligations. [86] When policies are targeted at buildings with an EPC rating below a certain threshold it should help ensure that the least energy efficient buildings are tackled first.

[84] Wuppertal Institute, 2015. Energy efficiency policies for buildings.

[85] Wuppertal Institute, 2015. Energy efficiency policies for buildings.

[86] JRC, 2014. Financing building energy renovations: current experiences & ways forward.

5. RECOMMENDATIONS

5.1. Recommendations for EU policymakers

A combination of tougher obligations, stronger incentives, more creative use of financial instruments, and improved implementation and enforcement of existing legislation are prerequisites to boost renovation as explained below.

5.1.1. Legislating to boost the scale and scope of building renovation

There is a need to improve coherence between the different pieces of legislation that have implications for building renovation i.e. EPBD, the EED and the RED. This would enable better exploitation of the synergies between the various policy instruments (EED, RED, Ecodesign Directive, Labelling Directive…).[87] An example of a potential synergy would be combining the work required on financial instruments, ESCOs, EEOS and expert training.[88]

Provisions to reduce energy consumption and GHG emissions of buildings are currently spread between several EU-wide policy instruments.[89] This fragmented landscape of policy instruments increases the reporting burden of MSs (as MSs have to report on the provisions included in each instrument separately) and hampers the coherent assessment of the effectiveness of overall EU investment (risk of double counting).[90]

The scope of the provisions of the EU policy instruments should be broadened. The provisions of the EU policy instruments to reduce energy consumption and GHG emissions of the building stock (which currently includes the overall building stock, different building typologies individually, and building components and elements) should be broadened to properly cover systems (i.e. heating, cooling and lighting).[91]

Policies should be designed so as to make better use of periodic opportunities when building work occurs (i.e. any aesthetic or maintenance work which is done on a building) to improve energy efficiency in a more cost-effective way.[92]

Broadening the scope of EU regulation for building renovation to increase its scale:

- Mandatory renovation requirements for buildings that do not meet defined minimum levels of energy performance.[93] In order to address the buildings with the worst energy performance, a minimum energy performance threshold target could be set for all buildings (varied according to building type) to be achieved within a given timeframe.[94] If this timeframe is missed, the building in question would be deemed unsuitable for occupation. This should go alongside financial support to achieve the higher energy standard.
- Other opportunities to boost renovation identified in the literature include:[95] make residential accommodation for households at risk of fuel poverty, e.g. social housing, meet the highest energy performance ratings within a specified timeframe in order to provide comfortable, affordable housing; Make building extensions as well as major

[87] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.
[88] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.
[89] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.
[90] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.
[91] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.
[92] Wuppertal Institute, 2015. Energy efficiency policies for buildings.
[93] BPIE, 2016. 9 ways to make Energy Performance of Buildings Directive (EPBD) more effective.
[94] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.
[95] BPIE, 2015. Renovation in practice. Best practice examples of voluntary and mandatory initiatives across Europe.

building services (e.g. cooling, heating) system changes conditional on the improvement of the overall energy performance of the building, and in the latter case, also conditional on an assessment of options for the introduction of renewables.

EU regulation needs to be more concrete. The various renovation concepts (major renovation, deep renovation etc) should be replaced by a single concept.[96] The EPBD should define the specific circumstances in which building owners are required to renovate their buildings by investing in energy performance improvements. This is already done in some EU Member States (e.g. Germany, France, the UK, Belgium, Italy and Denmark).[97]

Enforcing and facilitating reporting. The EED should oblige MSs to report on projected final energy savings from buildings against a long-term energy and/or carbon reduction target to 2050 with 2020 and 2030 milestones. These energy saving targets could be further specified for each measure or group of measures. Templates, with guidelines to make reporting systematic and straightforward, should be provided to Member States to monitor EED implementation.[98]

EU regulation needs to be more ambitious. The current renovation concepts should be replaced by a single and ambitious concept such as a 'net zero energy' consumption level, which combined with smart meters, will make monitoring of compliance and enforcement easier.[99] The target for Article 5 of the EED requiring Member States to renovate 3% of floor area of the Central Government estate every year, should be extended to include all public buildings, so that the whole public sector leads by example.[100]

5.1.2. Financing renovation

Finance for building renovation should be awarded on the "Energy Efficiency First" principle.[101] "Energy Efficiency First" is the principle of prioritising the potential for energy efficiency first in all decision-making related to energy (over expanding infrastructure for generation, transmission and imports) to redress the historic bias towards prioritising increasing supply over reducing demand.

Establish an EU Risk Sharing Facility.[102] This suggestion would enable more coherent use of public funding and provide continuous support to investments in energy renovation. This facility would provide loan guarantees to project aggregators, to reduce the risks that investors perceive. It would also enable low-interest rates at the local level. The facility could be established by bundling existing EU funding.

5.2. Recommendations for MS policymakers

Local/regional authorities in Member States are major potential players in the market transformation of the EU building stock. Besides ensuring the effective transposition of EU legislation, recommendations for this group are:

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96 Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

97 BPIE, 2016. 9 ways to make Energy Performance of Buildings Directive (EPBD) more effective.

98 EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

99 Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

100 BPIE, 2015. Renovation in practice. Best practice examples of voluntary and mandatory initiatives across Europe; Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

101 Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

102 Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

5.2.1. Assessment of the existing building stock - baseline

A **comprehensive census of their buildings** to give a consistent assessment of the status of the current building stock – i.e. a baseline – should be carried out by the Member States.[103] Data on the European building stock has significant gaps. Effective renovation strategies can only be implemented if Member States have good data to define baseline performance. This could be supported by setting up national EPC databases that provide a ready-to-use source of information on the building stock for policy making and allow monitoring of the implementation of EPCs at the MS and EU level.

5.2.2. Renovation legislation

Member States need to increase their ambition and revise their cost-optimal calculation methods. The cost-optimal methodology calculations of Member States show that a significant improvement is necessary to support renovation activities towards nZEB goals.[104] Analysis suggest that about 2/3 of the Member States' have potential to improve their approach by addressing the gap that exists between the ambitions set and the cost-optimal level, with about half of the Member States having a significant (larger than 15%) gap.[105]

5.2.3. Financing renovation

Increase the level of ambition for policy instruments aimed at boosting renovation. For the residential sector for instance, schemes that support renovation leading to minor energy savings could be abolished[106] in favour of incentives to reward more ambitious renovations.[107]

More emphasis on information dissemination and awareness raising regarding building renovation. This should include ensuring open-source access to all aspects of buildings performance data and the articulation of the multiple benefits of energy efficiency investments. Governments should provide information to improve the awareness levels of decision makers (public authorities, buildings owners and households)[108]. Market-based instruments are likely to become increasingly important in financing renovations.[109]

MS authorities should continue to work on translating EU funds (e.g. Cohesion fund) into well-designed and targeted stimulus instruments for boosting building renovation.[110]

5.2.4. Facilitating the (decision-making) process of renovation

Member states should **encourage the set-up of one-stop-shops** at the local / regional level as independent (from EU institutions) energy renovation facilitators. Their current role as information providers should be expanded so that they become renovation coordinators, bringing together all parties needed in the renovation process to ensure quality and timely

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[103] BPIE, 2016. 9 ways to make Energy Performance of Buildings Directive (EPBD) more effective.

[104] BPIE, 2016. 9 ways to make Energy Performance of Buildings Directive (EPBD) more effective.

[105] Ecofys, 2015. Assessment of cost optimal calculations in the context of the EPBD (ENER/C3/2013-414).

[106] Dubois, M. and Allacker, K., 2015. Energy savings from housing: Ineffective renovation subsidies vs efficient demolition and reconstruction incentives.

[107] CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).

[108] EEFIG, 2015. Energy efficiency, the first fuel for the EU economy. How to drive new finance for energy-efficiency investments. Part 1: Buildings (Interim Report).

[109] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

[110] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

delivery.[111] MS authorities should contribute to **clear roadmaps for renovation** by continuing to work on documentation to assist building renovation strategies.[112]

5.3. Recommendations on the best policy mix to remove barriers

A recent Wuppertal report on energy efficiency policies for buildings concluded with a summary of the optimum policy package. This package is equally relevant for building renovations. The key points of the package are:

- A clear vision and targets for energy efficiency need to be established at the highest government level.
- Allocate finance and resources for implementation of sectoral policies and addressing market imperfections simultaneously.
- At the sector-specific level, policy instruments such as regulations, incentives and financing and capacity building are important components of a comprehensive policy package for energy efficiency in buildings.[113]

To summarise the optimum policy package should do the following:

- Take synergies into account.
- Cover the full range of building types (and building ownership / occupation patterns) - but prioritise those with most potential energy savings.
- Address each of the barriers - prioritising those with most potential.
- Reflect the mix of building stock (and climates) across Europe.
- Prioritise the lowest cost / highest impact policies.

The policy package should consist of a combination of mandatory and voluntary schemes, in order to encourage participation and boost uptake. However, it should also be recognised that if results are not achieved then the voluntary aspects can need to become mandatory to target certain issues.

[111] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

[112] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

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ANNEXES

Annex A. Costs and burdens for property owners and landlords, authorities and tenants

Costs and burdens for property owners and landlords

- **Assessment costs -** Incurred by property owners in order to have their properties assessed and to arrange and finance any required improvements;
- **Installation costs** – of carrying out the works necessary to implement the energy efficient measures;
- **Financing costs** – of the renovation for the property owner (or tenant), depend on the conditions of the commercial loan obtained by the bank;
- **Hidden costs** – as result of contracts that are not clear, clean-up costs after the renovation, costs of not being able to inhabit or cook in the building / home (in the case the property owner is the occupier of the building / house) or lost rental cost (in the case of landlords);
- **Costs of understanding regulations** – to assess to what extent certain measures are allowed to be implemented in a building.

Costs and burdens for authorities related to supporting policies

- **Set up costs** (e.g. training staff to develop knowledge on the regulations, information campaigns of new legal duties to landlords);
- **Implementing, administrating and monitoring** of the supporting policies, including e.g. the set-up of databases on the building stock and its energy performance level;
- **Other annual costs**[114] such as advising on regulations, assessing compliance, dealing with complaints related to the supporting policies, costs for certifying temporary exemptions, etc.

Costs and burdens for tenants

The costs and burdens for tenants mainly revolve around **potential rent increases** – depending on if, and to what extent, the costs of energy efficiency improvements for landlords will/ can be passed onto tenants.

In addition, tenants may also need to bear the burden of some of the aforementioned hidden-costs, for example, clean-up costs after the renovation, or the costs of not being able to inhabit or cook in the building / home (if the tenant was already inhabiting the house when the renovation works started).

[114] Annual costs: One local authority indicated an average annual cost of around £53,000 based on 0.5 FTE Housing Office; 1 Technical Officer; 0.1 Senior Officer. These are costs for an average year. It is expected that annual costs will be higher in the run to up the minimum energy efficient standard coming into force and the first few years after the policy has come into force.

Annex B. Benefits of renovation

B.1 Environmental benefits

Energy savings and GHG emission reductions

Deep renovation[115] can lead to a 75% reduction in final energy comsumption by 2050 (compared to 2010).[116] By 2050 it would also lead to a 95% reduction in gas consumption (from 1,653 TWh in 2015 to 82 TWh) and of 97% in oil consumption (from 745 TWh to 19 TWh).[117]. A high efficiency scenario, savings in peak demand for electricity could be as high as 57 GW (over one-tenth of the EU's total) by 2050 compared to a low efficiency scenario, resulting in savings on power generation capacity of EUR 89-153 billion up to 2050.[118] Deep renovation can generate significant GHG emission reductions (up to 90% savings by 2050 compared to 1990).[119]

Reduced usage of materials

Impacts on waste and input materials can also be expected.[120] More than 30-50% of total material use in Europe goes to housing[121]. Around 65% of total aggregates (sand, gravel and crushed rock) and approximately 20% of total metals are used by the construction sector.[122]

For renovation of existing buildings, less material is required per square meter than for construction of new buildings. Increasing the rate of renovation compared to demolition and subsequent new build could therefore decrease future levels of construction and demolition (C&D) waste generation. C&D waste is about 33% of total EU waste generated.[123]

B.2 Economic benefits

Employment

Energy efficient renovation of buildings supports employment. It has been calculated to generate about 19 jobs for every million euros invested[124]. Other studies estimate 12 – 17 jobs per million euros invested.[125] Estimates of employment creation differ from source to source, probably due to the different depths of renovation possible and the different targets that are being explored. A 2014 study for Eurima, states that a 'deep renovation' scenario[126] would lead to the creation of an additional 1.4 million jobs by 2050.[127] If an energy savings

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[115] Deep renovation defined as "a high level of energy efficiency improvement at a rate of 2.3% of the building stock, with a high focus on the efficiency of the building envelope and high use of renewable energy".

[116] Ecofys, 2012. Renovation tracks for Europe up to 2050.

[117] Ecofys/Eurima, 2014. Deep renovation of buildings. An effective way to decrease Europe's energy import dependency.

[118] Ecofys, 2015. The role of energy efficient buildings in the EUs future power system.

[119] Ecofys/Eurima, 2014. Deep renovation of buildings. An effective way to decrease Europe's energy import dependency.

[120] http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_ener_001_epbd_smart_buildings_en.pdf.

[121] EEA, 2010. SOER2010 Material resources and waste — SOER 2010 thematic assessment.

[122] Ecorys, 2014. Resource efficiency in the building sector.

[123] EEA, 2010. SOER2010 Land use — SOER 2010 thematic assessment.

[124] Copenhagen Economics, 2012. Multiple benefits of investing in energy efficient renovation of buildings. Ratio from Janssen, R. and Staniaszek, D., 2012. How many jobs? A survey of the Employment Effects of Investment in Energy Efficiency of Buildings.

[125] IEEP, 2013. Review of costs and benefits of energy and savings.

[126] Deep renovation defined as "a high level of energy efficiency improvement at a rate of 2.3% of the building stock, with a high focus on the efficiency of the building envelope and high use of renewable energy".

[127] Ecofys/Eurima, 2014. Deep renovation of buildings. An effective way to decrease Europe's energy import dependency.

target of 40% is adopted for 2030, the EU energy renovation market could increase by almost half its current size, leading to more than one million additional jobs.[128] This implies that the number of jobs created in the sector is positively correlated to the ambition of the renovation and energy saving targets set by authorities. Estimates from the industry are more optimistic and predict the number of additional jobs stemming from energy-efficient renovation (without specifying to what depth i.e. deep renovation or not) would be 2 million by 2020 and additional 1.1 million on average per year until 2050.

In addition to this, renovation enhances the resilience of the construction sector in the face of a crisis, as evidenced by the experience in recent years.[129] Employment dropped drastically in countries where the construction sector focused mainly on new build construction projects as compared to countries in which the fraction of renovation activities was higher.

GDP and public budgets

A 2012 study[130] showed that EUR 1 billion of energy efficiency investments, had an impact on GDP of EUR 0.88 – 1.06 billion. In addition, energy efficiency improvements in buildings can ease pressure on public finances (i.e. budgets of national authorities), by generating increased tax revenues through increased economic activity and by reducing government expenditure on energy[131] and unemployment benefits[132].

Innovation & sectoral modernisation

Boosting energy efficient renovation should improve competitiveness and innovation in the European construction and energy services industries.[133]

Energy security & energy infrastructure

The EU's dependency on energy imports is up to 90% for crude oil and 66% for natural gas[134], differing per Member State. This is particularly important for those Member States that are solely reliant on imported gas from one single supplier namely Belgium, Estonia, Czech Republic, Latvia, Lithuania and Portugal.[135] A 2014 study[136] suggests that deep renovation[137] would reduce buildings gas consumption by 95% by 2050 and of oil consumption by 97%.

Productivity benefits

Literature[138] suggests that improvements in energy efficiency, leading to improved indoor air quality and thermal comfort, has productivity benefits. These result from fewer days of work

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[128] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

[129] JRC, 2015. Energy renovation: The Trump Card for the New Start of Europe.

[130] Copenhagen Economics, 2012. Multiple benefits of investing in energy efficient renovation of buildings.

[131] http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_ener_001_epbd_smart_buildings_en.pdf.

[132] Copenhagen Economics, 2012. Multiple benefits of investing in energy efficient renovation of buildings.

[133] http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_ener_001_epbd_smart_buildings_en.pdf.

[134] COM (2014) 330 final - EU Energy security strategy.

[135] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

[136] Ecofys/Eurima, 2014. Deep renovation of buildings. An effective way to decrease Europe's energy import dependency.

[137] Deep renovation defined as "a high level of energy efficiency improvement at a rate of 2.3% of the building stock, with a high focus on the efficiency of the building envelope and high use of renewable energy".

[138] Wyon, D. P., 2004. The effects of indoor air quality on performance and productivity. Indoor air, 2004, 14 suppl 7 Page 92-101. International Centre for Indoor Environment and Energy, Technical University of Denmark, Denmark; World Green Building Council, 2014. Health, Wellbeing & Productivity in Offices. The next chapter for green building; Fisk, W., Seppanen, O., 2007. Providing better indoor environment quality brings economic

missed. A study[139] estimates that every euro invested in insulation, results in 0.78 euros benefit in reduced days of work missed. Productivity improvements due to better air quality can reach 8-11%.[140]

B.3 Social benefits

Health benefits

Renovation reduces energy demand, which reduces energy production and associated air pollution from burning fossil fuels. As mentioned above it also improves indoor air conditions. Both of these points decrease respiratory diseases and improve productivity.[141]

Wellbeing / comfort benefits

Renovation is also a key issue in the reduction of the level of severe housing deprivation in Europe. Eurostat defines severe housing deprivation as "the percentage of the population which is considered overcrowded", while also exhibiting at least one of the housing deprivation measures (leaking roof, no bath/shower/ no indoor toilet, high level of darkness in dwelling).[142]

Energy poverty

The share of the EU population unable to keep their homes warm -which impacts health and comfort- increased from 9.5% in 2010 to 10.2% in 2014.[143] Building renovations should reduce energy poverty by cutting energy bills. This should also reduce the number of households that are unable to pay their utility bills on time due to financial difficulties, i.e. decrease the proportion of the population with arrears on utility bills. In 2013, around 10 per cent of the households in the EU28 were in arrears with energy utility bills.[144] The majority of these households were in South Eastern Europe – Greece, Romania, Bulgaria, Croatia and Hungary.

Increased property value

Both property value and rental income can be assumed to increase from renovation of properties with energy efficiency measures.[145] A study found that a property with an EPC A rating is typically worth 11% more, and can attract 1.9% higher rent, than a D rated property in the same location.

benefits. Published in proceedings of Climate 2007. Lawrence Berkeley National Laboratory, University of Berkeley and Helsinki University of Technology, Finland.

139 Copenhagen Economics, 2012. Multiple benefits of investing in energy efficient renovation of buildings. Ratio derived from Barnard et al, 2011. Warm Up New Zealand.

140 World Green Building Council, 2014. Health, Wellbeing & Productivity in Offices. The next chapter for green building.

141 Element Energy, 2016. Minimum thermal efficiency standards for rental properties.

142 Ecorys, 2014. Resource efficiency in the building sector.

143 Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

144 Micklitz, H. W., & Domurath, M. I. (2015). Consumer debt and social exclusion in Europe. Ashgate Publishing, Ltd.

145 Element Energy, 2016. Minimum thermal efficiency standards for rental properties.

Annex C. Barriers to renovation

C.1 Financial barriers

Renovation costs

The (high) upfront costs of renovation and the long payback for some measures are probably the most important barriers found in literature.

Access to finance

There is a lack of standard financial approaches for building renovation (e.g. agreed protocols and benchmarking rules for private capital investment, 'ready to use' financial products). The Energy Efficiency Financial Institutions Group (EEFIG) highlighted the need for a strong regulatory framework accompanied by financing-related measures such as improvement of public procurement rules, standardisation of investment procedures or better monitoring of energy performance.[146]

Low energy prices / energy as a minor part of the budget

Low energy prices are a major barrier for countries in which the energy costs are a small part of the overall budget of a real estate company and of the rents for the tenants, as is the case in Denmark. This reduces the financial value of the energy savings that renovation to a high standard of energy efficiency generates, and affects the payback period.[147]

C.2 Technical barriers

Lack of technical solutions

Although technology is not generally a significant barrier for building renovation, energy efficient approaches may not be easily available in some cases (for example because of the historic nature of the building component in question) or there may be uncertainties as to whether the new technologies will perform reliably.[148]

Cost of technical solutions

The affordability of certain technical solutions is a problem.[149]

Complexity of renovations and associated lack of knowledge of construction professionals

Many construction professionals still lack training and experience with some of the methods and materials required to deliver successful energy efficiency renovations. Different authors

[146] http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_ener_001_epbd_smart_buildings_en.pdf.

[147] Total Concept, 2014. Energy Renovations of Non-residential Buildings in Northern European Countries. National non-technical barriers and methods to overcome them.

[148] BigEE/ Wuppertal, 2015. Energy efficiency policies for buildings.

[149] ZenN – Nearly Zero energy Neighborhoods, 2013. Common barriers and challenges in current nZEB practice in Europe D.1.1. Report.

agree that better supply side collaboration structures between SMEs are needed[150] and/or that professionals are key to tackling this issue. [151]

C.3 Process barriers

Fragmentation of the supply chain

Some feel [152] that the lack of a single party willing to offer integrated housing renovation as a service, is a key barrier to low energy (particualry near zero energy) renovations. At present the need for mutliple parties to work together on a construction project is a constraint.

Complexity of renovation and associated burdening of home owners

Renovation of buildings requires building/housing owners to contract various different parties (architects, energy advisors, contractors, etc.) for each type of specialised work. The financial instruments available for renovation are also not always clear.[153]

C.4 Regulatory barriers

Varying ambition of performance requirements

All Member States have introduced EPCs, but their quality, reliability and market acceptance varies which undermines their credibility. The EPBD could set national guidelines for their implementation, encourage independent control and enforce penalties for non-compliance.[154]

Multiple definitions for renovation

The EED uses five 'renovation' concepts: 'deep' 'cost-effective', 'staged deep', 'substantial refurbishment' and 'comprehensive'. The EPBD focused on the concept of 'major renovation'. These different terminologies and definitions cause confusion.[155]

C.5 Awareness barriers

Individuals are often insufficiently acquainted with the energy performance of their building (insulation and performances of equipment) and with the comfort and quality of life an energy-efficient retrofit can bring, although the degree of unfamiliarity varies between countries.[156]

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[150] IEA, 2010. Policy pathways: energy performance certification of buildings; Hoppe, T., 2012. Adoption of innovative energy systems in social housing: Lessons from eight large-scale renovation projects in The Netherlands. Energy Policy, 51, 791–801; Mlecnik, E., Kondratenko, I., Haavik, T., 2013. Opportunities and Barriers related to Supply Chain Collaboration for Delivering Integrated Single-Family Home Renovations. Presented at the CIB World Building Congress 2013 in Brisbane, 5-9 May 2013.

[151] Mlecnik, E., Kondratenko, I., Haavik, T., 2013. Opportunities and Barriers related to Supply Chain Collaboration for Delivering Integrated Single-Family Home Renovations. Presented at the CIB World Building Congress 2013 in Brisbane, 5-9 May 2013.

[152] Mlecnik, E. et al., 2012. Opportunities and barriers for business modelling of integrated energy renovation services. PassivhusNorden, 2012; Mahapatra, K. et al., 2013. Business models for full service energy renovation of single-family houses in Nordic countries. Applied Energy, 112, 1558–1565; Mlecnik, E., 2013. Opportunities for supplier-led systemic innovation in highly energy-efficient housing. Journal of Cleaner Production, 56, 103-111.

[153] CA EPBD, 2016. Implementing the Energy Performance of Buildings Directive (EPBD).

[154] BPIE, 2016. 9 ways to make Energy Performance of Buildings Directive (EPBD) more effective.

[155] Saheb, Y., 2016. Energy Transition of the EU Building Stock. Unleashing the 4th Industrial Revolution in Europe.

[156] Beillan, V. et al., 2011. Barriers and drivers to energy-efficient renovation in the residential sector: Empirical findings from five European countries. ECEEE Report.

Annex D. Renovation levels and energy savings targeted or expected by MSs[157]

Member State	Target/ Estimation	Energy savings
Austria	Estimated	3% building sector energy use reduction in the in 2020, compared to 2013.
Belgium (Brussels Capital Region - BCR)	n/a	n/a
Belgium (Wallonia)	n/a	n/a
Belgium (Flanders)	Estimated	4288 GWh of final energy and 4581 GWh for primary energy saved by 2020.
Bulgaria	n/a	n/a
Croatia	Targeted	80% reduction of GHG emissions in buildings for of national building stock by 2050.
Cyprus	n/a	n/a
Czech Republic	Estimated	77 PJ saving of energy (45% reduction compared to current consumption) for heating in residential buildings.
Denmark	Estimated	35% reduction in net energy consumption for heating and hot water in the building stock by 2050, compared to 2011.
Estonia	Targeted	3.5 PJ/y energy savings the building sector to be achieved by 2016.
Finland	Estimated	-8% energy consumption by 2020, -37% by 2050 (-8115 GWh by 2020, -36889 GWh by 2050).
France	Targeted	38% reduction of energy consumption of buildings by 2020 AND 400.000 dwellings per year should be energy-renovated starting from 2013.
Germany	Estimated	337 PJ/year energy savings for period 2008-2020.
Gibraltar	Estimated	6.7 GWh of primary energy saved by 2020 and 88.8 GWh by 2050.
Greece	Targeted	At least 80% of the existing building stock renovated by 2050.
Hungary	Targeted	49PJ/y primary energy saving for the building sector at 2020.
Ireland	Targeted	A nearly-zero emissions building sector by 2050; %33 reduction of energy usage in the public sector by 2020.
Italy	Targeted; Estimated	4.9 Mtoe/y final energy savings of the building sector by 2020 (3.67 Mtoe/y in the residential sector, 1.23 Mtoe/y in service sector) have been targeted; it is estimated that this could lead to a 24% reduction of primary

[157] Data was not available for: Belgium (Wallonia region and BCR), Bulgaria, Cyprus, Luxembourg, Malta, Poland, Portugal, Romania, Spain, United Kingdom.

Member State	Target/ Estimation	Energy savings
		energy consumption in comparison with the business as usual scenario.
Latvia	Targeted; Estimated	50% reduction of consumption of thermal energy for heating against the current indicator is the target to be achieved by 2030. It is estimated that by renovating 3% of State owned and used building areas each year, 186 GWh energy savings could be achieved over the period 2014–2020.
Lithuania	Targeted	At least 500 GWh of thermal energy to be saved (i.e. for space heating) by 2020.
Luxembourg	n/a	n/a
Malta	n/a	n/a
Netherlands	Targeted	300,000 existing buildings per year to improve by at least two energy label steps; Average social rental property to achieve label B; 80% of private rental to achieve minimum label C by 2020; At least an average energy label A for buildings by 2030.
Poland	n/a	n/a
Portugal	n/a	n/a
Romania	n/a	n/a
Slovakia	Estimated	6928.6 GWh energy savings up to 2030.
Slovenia	Targeted	At least 16% final energy consumption in building decreased by 2020; 30% by 2030 (compared to 2005); almost carbon-free energy use in the building sector by 2050.
Spain	n/a	n/a
Sweden	Estimated	12-25% reduction of final energy consumption for heating and domestic hot water (DHW) in buildings.
United Kingdom	n/a	n/a

Source: Adapted from Castellazzi L., Zangheri P., Paci D., 2016. Synthesis Report on the assessment of Member States' building renovation strategies.

Annex E. A selection of policy measures in EU Member States

This annex describes the following policy measures:

- Denmark – EEOS successful in increasing energy efficieny and generating energy savings
- Slovakia – MunSEFF II: The Municipal Sustainable Energy Financing Facility
- Spain – Complying with the EED through Alternative Measures instead of EEOS
- Belgian grants in Brussels Region for energy efficiency in buildings
- Italy and France - Tax credit
- Germany - The KfW's programmes
- Finland - The Energy Audit Programme
- The Netherlands – The Dutch Covenant on Energy Saving in the Rental Sector
- The United Kingdom (England and Wales) – Private Rented Sector Regulations
- France – Habiter Mieux (Living Better) Programme

E.1 Denmark – EEOS successful in increasing energy efficiency and generating energy savings

The Danish EEOS consists of voluntary agreements negotiated between the Danish Energy Agency and the energy utilities.[158]

The country started to develop its EEOS in the 1990s with electricity distribution companies and the scheme was eventually expanded to include natural gas suppliers (2004) and oil and district heating companies (2006).[159] The scheme sets an energy efficiency target for the different industries, in relation to their yearly sales of energy. The companies that are obliged to take part are distribution companies for electricity, natural gas, district heating and oil (there are three gas companies, six oil companies, 74 electricity companies and 417 district heating companies).[160]

As can be seen from Figure 13 there has been an overachievement of the target every year since the implementation of quantified targets and requirement to document the realisations in 2006, except for 2013.

The Danish obligations under the energy policy agreement are considerably higher than required by the Directive. In 2013 and 2014, the annual target for the Danish energy efficiency obligation was 10.7 PJ, corresponding to 2.6% of energy end use, which for the period 2015-2020 was raised to an annual target of 12.2 PJ, corresponding to around 3.0% of energy end use.[161]

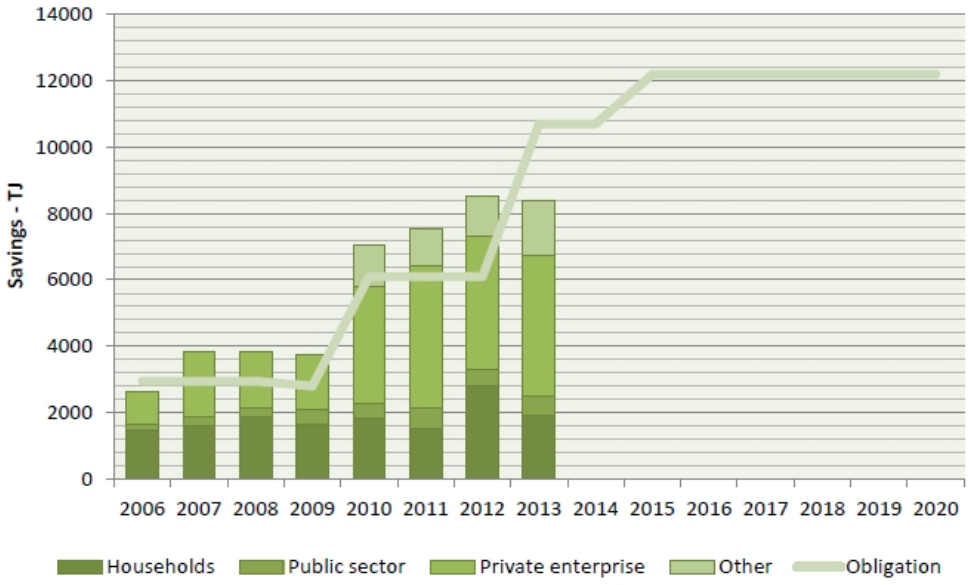
[158] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

[159] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

[160] ENSPOL, 2015. Energy Saving Policies and Energy Efficiency Obligation Scheme, D2.1.1: Report on existing and planned EEOS in the EU – Part I: Evaluation of existing schemes.

[161] https://ec.europa.eu/energy/sites/ener/files/documents/2014_neeap_en_denmark.pdf.

Figure 13: Total annual total energy saving per sector compared to targets DK



Source: Danish Energy Agency

The following figure indicates the costs of the EEOS for each obligated sector (in 2013) and compares it to the target. In addition, the administrative cost paid by the Danish Energy Agency amounts to approximately EUR 540,000 annually.

Table 19: Total cost and energy savings in each obligated sector in 2013

Obligated sector	Total cost mio. €	MWh, 1st year final energy savings	Cost € cent/kWh 1st year end use savings
Electricity DSO	58.3	960000	6.1
Gas DSO	29.2	538842	5.4
District heating	33.8	719060	4.7
Oil companies	3.7	819510	4.5
Total	125.0	2299853	5.2

Source: Danish Energy /regulatory Authority

E.2 Slovakia – MunSEFF II: The Municipal Sustainable Energy Financing Facility [162]

The **Municipal Sustainable Energy Financing Facility (MunSEFF)** was an initiative launched by the European Bank for Reconstruction and Development (EBRD) and the European Commission to develop and stimulate commercial bank financing to municipalities and their utility companies in Slovakia. The programme, designed to run between 2007 and 2010, aimed at stimulating implementation of energy efficient renovation of municipal infrastructure. As such, eligible sub-borrowers for MunSEFF II were municipalities, housing associations, public or private companies providing municipal services, and Energy Service

[162] http://www.munseff.eu/en/index.html.

Companies (ESCOs) implementing energy efficiency investments in co-operation with one or more municipalities.

Given the increased demand for support, the EBRD launched the second phase of the Facility, MunSEFF II, designed to reach an even larger variety of municipal projects. The second phase run until December 2015.

During its course, MunSEFF supported 403 projects, including energy efficiency improvements in 114 municipal buildings, 219 residential buildings and 70 municipal infrastructure projects. The total loan amount reached about EUR 84.5 million with the total investment costs of more than EUR 92.5 million. The programme was supported by an EU grant of EUR 21.3 million used for investment incentives and the provision of technical assistance to its partner banks and sub-borrowers. Projects financed under MunSEFF will lead to annual primary energy savings of 79 GWh - equivalent to the household electricity consumption of the Slovak city of Trnava with about 70,000 inhabitants - and annual greenhouse gas emission reductions of 15,000 tonnes of CO_2 equivalent.

E.3 Spain – Complying with the EED through Alternative Measures instead of EEOS

Spain has opted for so-called Alternative Measures instead of EEOS, as the latter faced resistance from industry including fuel product suppliers and some utilities, which stakeholders have described as being oligopolistic and influential.[163] However, EEOS are planned to be implemented in the near future.

One main Alternative Measure adopted to comply with the EED has been the **National Energy Efficiency Fund** (Fondo Nacional de Eficiencia Energetica – FNEE), set up as an alternative to taxes and standards. The FNEE is a simple fund that subsidises projects for sectors and regions regarding energy efficiency measures mainly in housing and non-residential buildings. The fund is financed by energy providers based on the calculation of the estimated costs for each of them to reach a 1.5% net reduction in energy sales. Funding from FNEE can also be used with EU Structural and Investement Funds to co-finance measures, which means that much of the FNEE is then managed by the autonomous communities, which are in charge of the Structural Funds. The fund has faced criticism, because it has been unable to disburse the funds effectively and has partially been captured by vested interests.

[163] EP, 2016. Implementation of the Energy Efficiency Directive (2012/27/EU): Energy Efficiency Obligation Schemes. European Implementation Assessment.

E.4 Belgium (Brussels Region) – Grants for energy efficiency in buildings

The program **Exemplary Buildings (Bâtiments Exemplaires)**[164] ran from May 2007 until December 2014 in the Brussels Region in Belgium. It is regared as a success story regarding the implementation of the EPBD in Europe[165]. The programme consisted of a multi-annual demonstration program related to energy and buildings and was managed by Bruxelles Environnement – Leefmilieu Brussel, an institution which provides citizens with information and assistance with all financial subsidies available for citizens of of Brussels wishing to renovate their buildings. Within this program, funds were awarded for the construction or renovation of buildings that are at the forefront in terms of energy and environmental performance. This resulted in around over 90 public and private renovation projects to (more or less) passive building standards.

Figure 14: Bâtiments Exemplaires programme poster

At present, as a continuation to Bâtiments Exemplaires, '**Be.Exemplary**'[166], a new call for innovative and ambitious projects of exemplary buildings has been issued by the regional government in Brussels. Be.Exemplary is open to all building owners who build or renovate in Brussels: individuals, public, parastatal and private companies institutions powers (developers, businesses, non-profit organisations, etc.).

Figure 15: Be.Exemplary programme logo

Another exemplary policy measure in the Brussels Region is the energy management programme **PLAGE ("Plan Local d'Action pour la Gestion Énergétique")**. The Plan, which started in 2005, originally targeted real estate owners or occupants with buildings covering more than 100,000 m^2 overall, obliging them to reduce their energy consumption by implementing energy management measures. The size threshold was later lowered to 50,000 m^2. Energy efficiency targets are also being set for public actors by a decree currently under implementation. The targets correspond to a 10% reduction of the annual energy consumption that will have to be achieved in four years.[167]

E.5 Italy and France - Tax credit[168]

Tax credit for energy efficiency improvement in Italy's residential sector

Italy provides a tax credit equivalent to 65% of the total expenditure (up to EUR 100,000 per project) for energy efficiency improvement measures in residential buildings. It covers a list of individual measures (including insulation, window replacement, condensing gas boilers

[164] http://www.environnement.brussels/thematiques/batiment/sinspirer-des-batiments-exemplaires.
[165] http://www.epbd-ca.eu/outcomes/2011-2015/CA3-2016-National-BELGIUM-Brussels-web.pdf.
[166] http://www.beexemplary.brussels/.
[167] Castellazzi L., Zangheri P., Paci D., 2016. Synthesis Report on the assessment of Member States' building renovation strategies
[168] JRC, 2014. Financing building energy renovations: current experiences & ways forward

and heat pumps) and also offers the option of a comprehensive retrofit package (which requires a 20% minimum reduction in primary energy demand for heating).

The total costs (public and private) of the Italian scheme were estimated to be 13 euro cents/kWh of saved energy. The total investment was EUR 15.5 billion (2007-2011) with a tax expenditure of around EUR 8.5 billion for the same period. According to the ex-post assessment, it led to energy savings of 7,700 GWh/year.

Sustainable Development tax credit in France
This income tax credit is applicable to several energy efficiency measures, energy efficient products and also to the realisation of an energy performance diagnosis (i.e. survey). The level of support ranges from 10-32% depending on the measure, with the maximum amount determined by the number of inhabitants.[169] This can be declared over a period of 5 consecutive years. The programme reached 1.3 million households in 2010 with a total investment of EUR 11 billion and expected energy savings of 6,630 GWh/year.

E.6 Germany - The KfW's programmes[170]

The **KfW's programmes** provide owners with subsidies, including loans with low interest rates and long durations, thus lowering investment costs for energy efficient renovations.[171] 280,000 flats were renovated per year between 2006 and 2010 leading to annual energy savings of 2.1 TWh and emissions reductions of 750 kton CO_2. The average annual public budget contribution was 10% of the total investment of EUR 14 billion. In 2011 it was EUR 0.95 million of the total EUR 18 billion investment costs.

Direct benefits are energy savings of 1.25 TWh per year and indirect benefits include 251 000 person years of additional employment.

E.7 Finland - The Energy Audit Programme[172]

In Finland, an Energy Audit Programme (EAP) has been in place since 1992. It is a voluntary programme for industry where the Ministry of Employment and Economy provides a 40-50% subsidy (participants cover the remaining costs). The programme is run by Motiva Oy, a state owned company, whose responsibilities include: promotion of audit activities, development of auditing models, monitoring, training of energy auditors and the quality assurance of audits. The audits themselves are mainly carried out by private consulting companies.

Between 1992 and 2007 it covered almost 40% of the building stock.[173] By the end of 2011, virtually all energy use in industry had been audited at least once.

- **Impact on energy and emissions:** The average savings potentials between 1995 and 2011, in non-intensive industry were 18% in heat and fuels, 6% in electricity and 7% in water consumption. For the energy intensive industry these figures were much lower. The installation rate of the proposed measures is approximately 70% in the service sector and 55% in industry. This translated into annual savings of EUR 78 million, or 2.8 TWh in industry by the end of 2011. Cumulative savings from the programme since 1992 up to 2011 were about EUR 360 million of which 70% came

[169] 8,000 euro for a single person; 16,000 euro for a couple (with additional 400 euro per dependant) and 8,000 euro per dwelling unit for a landlord (maximum 3 units).
[170] IEEP, 2013. Review of costs and benefits of energy and savings.
[171] EUPOPP, 2010. Impact Assessment Paper-Minimum energy performance standards for buildings in Germany.
[172] JRC, 2014. Financing building energy renovations: current experiences & ways forward.
[173] Maio et al., 2012. Cited in IEEP, 2013. Review of costs and benefits of energy and savings.

from industry.[174] For end users the result of the EAP is an annual return, with the ratio between return and energy savings in the range of 0.9-1.1 €/GJ.

- **Estimated costs for government:** Government support between 1992-2011 reached EUR 31,5 million, with the total cost of audits being EUR 72 million. A 2006 evaluation stated that cost efficiency for government, as a ratio between costs and energy savings (including free rider effect), is 0.09-0.11 €/GJ without costs for the VA scheme or 0.15-0.18 €/GJ, including these costs.

E.8 The Netherlands – The Dutch Covenant on Energy Saving in the Rental Sector[175]

A number of housing corporations in the Netherlands have set up a voluntary agreement, committing to reach a certain energy performance level (B rating on average) in their building stock by 2020. The covenant is expected to cover almost 2 million properties. Between 2011 and 2013 it led to a 20% reduction in gas consumption and a 4% reduction in electricity consumption. The housing corporations are expected to cover all costs, but may request support from the government for research and technical assistance.

The details of the agreement are as follows. By 2020, for all rental properties in the Aedes (association of housing corporations in the Netherlands) and Woonbond (National association of tenants and home seekers) stock (total available rental housing of housing corporations), the target is that an average energy index of 1.25 (average energy label B) should be achieved. This is in line with the target of a 33% reduction in energy consumption in existing social housing in the period of 2008-2020 (from article 1 of the Covenant). By 2020, 80% of rental properties in the Vastgoed Belang (association of private property owners) stock should achieve an energy label of C or better (from article 1). The backstop date for all buildings to meet these minimum standards is 31 December 2020.

The Dutch Ministry of Interior Affairs and Kingdom Relations has committed to providing financial assistance for some of the activities required to deliver this covenant[176], as well as providing favourable interest rates on loans and committing that 5-10% of the European Regional Development Fund (ERDF) will be allocated towards these renovations. The Ministry is also using an innovative scheme called Energiesprong (Energy Leap) to provide additional advice on how to best stimulate energy efficiency investments in rental buildings, using bill savings to fund retrofits, thereby ensuring no additional costs to tenants. The scheme is focused on social housing and aims to fund the investments in retrofit through bill savings, ensuring no net additional cost to tenants. Houses are renovated to the point where they become (almost) energy neutral and there are no longer energy bills for the tenants. Instead of paying their energy bills, tenants pay a similar amount to the housing associations, in order that they recover their investment. Using this money, the corporations pay building companies to retrofit the houses cost-effectively. (The necessary upfront capital comes from the WSW social bank, which has provided EUR 6 billion to underwrite government-backed 40-year loans to housing associations). Key to the scheme is that it is an area-based approach, using retrofit technology that can be introduced rapidly. A government contract will see 111,000 homes retrofitted, equivalent to an investment of EUR 6 billion.

Some results of this initiative are:

- CO_2 reduction/m^2 2011-2013: 15.6%
- Gas consumption reduction/m^2 2011-2013: 19.4%

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[174] Maio et al., 2012. Cited IEEP, 2013. Review of costs and benefits of energy and savings.

[175] Dutch Ministry of Interior Affairs and Kingdom Relations (2012). Convenant Energiebesparing Huursector 28 juni 2012.

[176] Dutch Ministry of Interior Affairs and Kingdom Relations (2012). Convenant Energiebesparing Huursector 28 juni 2012.

- Electricity consumption reduction/m^2 2011-2013: 4.3%
- Heating consumption increase/m^2 2011-2013: 0.3%

E.9 The United Kingdom (England and Wales) – Private rented sector regulations

In England and Wales Minimum energy standard for rentals have been introduced. The aim is that all buildings in the private rental sector with an EPC rating of F or G are improved to an EPC Rating E. The policy has a 'soft start': Landlords only have to comply after 1st April 2018 upon tenancy renewal, or once a new tenant moves in. Also, landlords will have the opportunity to make use of one or a combination of: 1) taking out a Green Deal (subject to meeting the 'Golden Rule'); 2) using Energy Company Obligation (ECO) funding where available; 3) obtaining a local or central Government grant.[177]

The major benefits of this policy are energy savings, followed by comfort and air quality benefits. The policy will also contribute to alleviating fuel poverty and supporting job creation in the green construction sector. The main benefits and costs are associated with F and G rated properties moving to an E rating. There are also costs associated with understanding the new regulations, as well as costs met by local authorities for having to regulate this new law. The Green Deal (until 2015) and other funding options served to reduce upfront capital costs for landlords. Landlords may also be able to pass on some of their costs onto tenants through marginally higher rent charges, depending on local market conditions. Landlords must undertake those measures that meet the Green Deal Golden Rule (i.e. repayments must not be any larger than the expected energy bill savings taking into account any funding available from Green Deal Finance, ECO or grant source). To do this, they would first obtain a domestic Green Deal Assessment which would set out a recommended package of improvements for the property, including their expected bill savings.

The UK government's impact assessment of the approach calculated the following economic, environmental and social impacts:

- Economic impacts: Total costs are estimated to be around £2.4bn, and an overall a net benefit of around £2.0bn is predicted. Penalties for failing to comply with the policy. Penalties for a single offence (e.g. failing to meet the backstop date) may be cumulative up to a maximum of £5,000.
- Environmental impacts: 6.6 million tonnes of CO_2 equivalent change in greenhouse gas emissions traded (5.0 non-traded).
- Social impacts: By increasing the internal temperature of the buildings with the worst energy ratings in the rental sector, tenants will be less likely to fall ill and those with long term sickness may find the higher temperatures will be beneficial for their illness.

E.10 France – Habiter Mieux (Living Better) Programme

Habiter Mieux[178] is a seven-year fuel poverty funding programme (started in 2010) of the national agency of housing (L'Agence nationale de l'habitat (Anah) for rental property. It aims to complement existing financial incentives for energy renovations and to specifically target low/medium-income households (to fight energy poverty).

Its main design aspects are:

[177] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/335073/Consultation_Stage_Impact_Assessment_for_the_PRS_Regulations.pdf.

[178] http://www.anah.fr/proprietaires/proprietaires-occupants/etre-mieux-chauffe/.

- 50% coverage of the renovation works (Anah aids max EUR 10,000) if low income, 35% if middle income (max EUR 7,000 aid).
- A support of EUR 1,600 to 3,000 ecological solidarity grant + Anah grants (income ceiling up to EUR 20,000).
- The tenant has not benefited from an interest-free loan (Prêt à Taux Zero - PTZ) for the previous 5 years.

Although initially designed for low income rental housing only (2010), in 2013 the scope was extended to include co-owners and non-occupant owners and lifted the resource ceiling up to the median income. The target set was to renovate 300,000 households (older than 15 years) by 2017 achieving an average of 38% efficiency gains after renovations (beyond the 25% imposed threshold).

Other measures that go alongside this include Minimum Energy Performance Standards which are set at low energy consumption levels. Enforcement is through voluntary certification and financial support schemes (such as the Habiter Mieux programme). There are grants, interest free mortgages and tax breaks available for energy conservation measures, which are described in the guide to Home Energy Conservation in France.

The rules do not always require a specific level of energy performance to be achieved, notably with some of the tax credits that are available, although in all cases there are rules on the standard of performance of the materials and equipment to be used. In other cases, there is a general requirement to have an energy performance audit undertaken, with an assessment of the anticipated benefits of the work.

Results from impact assessments:[179]

- Economic impacts: In 2010-2013 grants were primarily given to households in rural areas who were also owners. Even after receiving the grants 37% of very modest income households and 49% of modest income households still have more than EUR 5,000 to contribute to financing renovations.
- Social impacts: Only 50,000 renovations were funded in 2010-2014 (against a target of 300,000 by 2017). Due to the extension of the scope in 2013, 46% of all landlords became eligible. This extension of the scheme has diverted most of the funds towards middle-class households to the detriment of the lowest-income households.
- Environmental impacts: Energy efficiency gains of 38% after renovations (beyond the 25% imposed threshold). However, stakeholders point out that in the absence of further obligations, renovations often result in the improvement of one single appliance or structure, without overall household energy efficiency gains.

[179] Insight-E, 2015. Energy poverty and vulnerable consumers in the energy sector: analysis of policies and measures.

NOTES

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