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EVALUATION
of Directive 2010/31/EU on the energy performance of buildings

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2010/31/EU on the energy performance of buildings

{COM(2016) 765 final}
{SWD(2016) 409 final}

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1. INTRODUCTION

1.1. Purpose of the evaluation

Pursuant to the Commission Better Regulation Framework[1], the present evaluation aims at a thorough assessment of the Energy Performance of Buildings Directive ('the EPBD' or 'the Directive')[2] in the light of experience gained and progress made during its application, against the following criteria: effectiveness, efficiency, relevance, coherence, and EU added value.

Energy efficiency, as a contribution to the moderation of energy demand, is one of the key dimensions to achieve a resilient Energy Union, based on a forward-looking climate policy. In this context, the European Commission decided to pay particular attention to sectors with an important potential for further efficiency increases, in particular buildings.

The existing EU core instruments in this context, the EPBD, the Energy Efficiency Directive[3] (EED), and several product regulations laying down minimum energy performance standards and putting energy performance information on labels[4] are delivering tangible results and have proved to be a solid basis for achieving energy savings in the buildings sector[5]. Amongst them, the EPBD is the main legislative instrument at EU level addressing the energy used in buildings.

The evaluation of the EPBD is a direct follow-up to the Communication on an Energy Union[6], which asked for a review and possible revision of the Directive by the end of 2016. The review of the Directive, including the *'Smart Finance for Smart Buildings'* initiative is one of the specific actions to improve the energy performance of buildings in the EU included in the Roadmap for the Energy Union[7]. The evaluation equally delivers on the legal obligation under Article 19 of the Directive, which asks for an evaluation to be completed by 1 January 2017.

Acronyms and definitions of specific terms in use in the present document are provided respectively in Annexes 1 and 2.

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1 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Better regulation for better results - An EU agenda; COM(2015) 215 final of 19 May 2015.

2 Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast); OJ L 153, 18.6.2010, p. 13-35.

3 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC; OJ L 315, 14.11.2012, p. 1-56.

4 Regulations adopted pursuing Directives 2010/30/EU on energy labelling and 2009/125/EU on ecodesign, for instance Regulations 811/2013 and 812/2013 on the energy labelling for heaters and combination heaters and on the energy labelling of water heaters and Regulations 813/2013 and 814/2013 on the ecodesign for heaters and combination heaters and on the ecodesign water heaters.

5 Communication from the commission to the European Parliament and the council Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy; COM(2014) 520 final of 23 July 2014.

6 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank - A framework strategy for a resilient energy union with a forward-looking climate change policy; COM(2015) 80 final of 25 February 2015.

7 Roadmap for the energy union; Annex 1 to COM(2015) 80 final of 25 February 2015.

1.2. Scope of the evaluation

The present evaluation aims at a thorough assessment of the EPBD in its entirety and for the whole European Union (EU).

Complementing the EPBD, the EED required Member States to establish, by April 2014, national long-term strategies for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. These strategies bring together different elements of the EPBD and of the EED and their assessment[8] is reflected in the current evaluation.

As it will be further explained in below Section 2, the EPBD recasts Directive 2002/91/EC[9], from which it retained the objectives, principles and several provisions. The application deadlines for Directive 2002/91/EC and for the EPBD were respectively 9 January 2006 and 9 January 2013. The transposition measures notified by Member States to transpose the EPBD were adopted from 2010 onwards[10]. A large number of legislative measures transposing the new provisions of the EPBD were adopted by amending or recasting pre-existing national/regional legislation adopted pursuant to Directive 2002/91/EC. At EU level, the application of transposition measures must therefore be seen as a progressive and continuous process, for which no precise starting point after 2006 can be established. For these reasons, the evaluation examines the impact of Directive 2002/91/EC and of the EPBD, looking in more detail at the changes introduced by the recast that created specific new obligations for Member States.

In order to detect any change of trends, the evaluation looks at energy consumptions and greenhouse gas (GHG) emissions during the period from 1990 until today, on the basis of the latest available data. The Impact Assessment of the EPBD[11] referred to the 2007 update of the PRIMES reference scenario[12], 2007 is therefore used as reference year.

2. BACKGROUND

The EPBD aims at promoting the improvement of the energy performance of residential and non-residential buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.

The EPBD defines the energy performance of a building as the amount of primary energy needed, in the use phase, to meet the energy demand associated with a typical use of the building, which includes, *inter alia*, energy used for heating, cooling, ventilation, hot water and built-in lighting (mainly in non-residential buildings).

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8 Synthesis Report on the assessment of Member States' building renovation strategies, 2015, European Commission (JRC)

9 Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings; OJ L 1, 4.1.2003, p. 65–71.

10 For example, the Danish Building Regulations were updated on 12 December 2010, the French RT2012 (new thermal regulation for new buildings) adopted on 26 October 2010, etc.

11 Communication Staff Working Document of 13 November 2008 accompanying the proposal for a recast of the EPBD – Impact assessment SEC(2008)2864

12 European energy and transport trends to 2030, update 2007, European Commission (written by E3M-Lab)

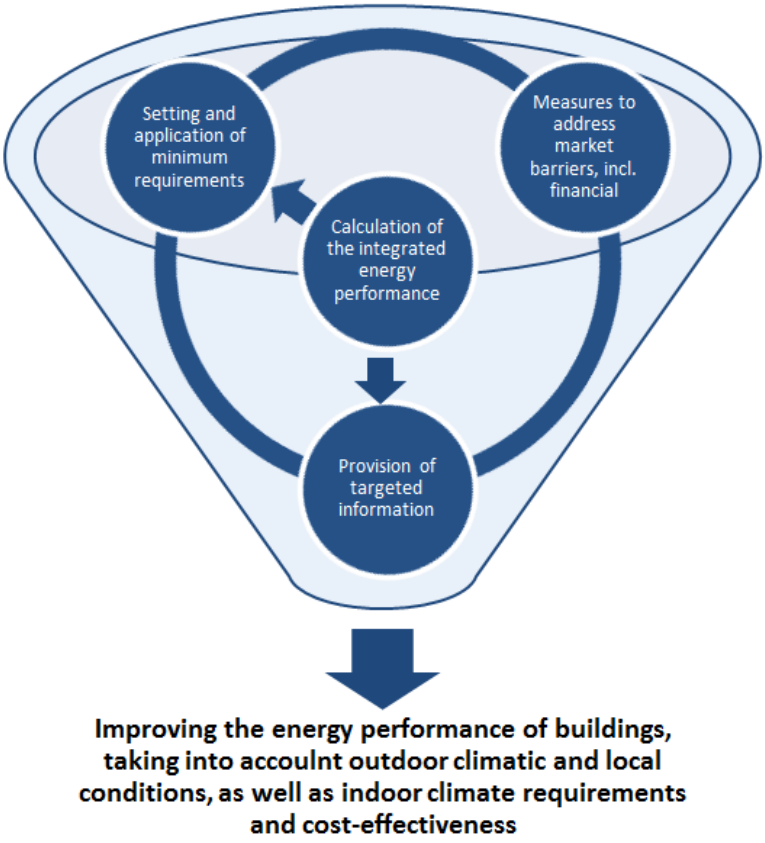
The intervention can be outlined as a three-pronged approach, as summarised by Figure 1:

- **Creating a demand-driven market for energy efficient buildings, with the provision of information through certification and inspection.**
  The EPBD does not mandate any investment but addresses information barriers. National Energy Performance Certificates schemes must be in operation for the issue, hand-over to the buyer or tenant and display of energy performance certificates (EPCs) and for the issue and hand-over to the owner or tenant of inspection reports. EPCs and inspection reports intend to provide information to building owners and tenants on the energy performance of their buildings, heating and air-conditioning systems, and on effective ways to improve these through building renovation works. Qualification schemes for experts, quality control and enforcement must be ensured, in particular through national independent control systems that Member States must set up in line with the EPBD. Providing users with the relevant information help them to take the best decisions;
- **Preventing that sub-optimal investments are made with minimum energy performance requirements set at cost-optimal level.**
  The EPBD requires Member States to set and ensure minimum energy performance requirements for all building works: new construction, major renovation of buildings, and the retrofit of building elements (e.g. windows, technical building systems). These minimum requirements must be periodically reviewed by Member States. A delegated act[13], accompanied by guidelines[14], establishes a harmonised comparative methodology framework for the calculation of cost-optimal levels of requirements for buildings and building elements. The reference to cost-optimality ensures reasonably ambitious levels of requirements. At the same time, Member States must ensure that, from the end of the decade onwards, only nearly zero-energy buildings (NZEB) are built. Enforcement mechanisms and rules on penalties must be in place;
- **Further catalysing the increase in energy performance of buildings and the transition to nearly zero-energy buildings with measures, including of financial and fiscal nature.**
  With the support of the EU, the EPBD requires Member States to establish measures and instruments, including those of financial and fiscal nature, to ensure the availability of capital needed to cover the costs associated with the upgrade of the energy performance of buildings. Article 7 of the EED acts directly on the renovation rate, requiring actual energy savings and therefore encouraging building renovation to take place in practice. Article 4 of the EED on renovation roadmaps acts indirectly on the renovation rate and on enhancing access to finance. It requires Member States to map their building stock and define a roadmap for its renovation, without actual obligation to implement those measures. These measures complement the EPBD, which acts on the depth of renovation and contains no requirements on how many buildings to be renovated, or by when.

[13] Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements; OJ L 81, 21.3.2012, p. 18–36.

[14] Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012; OJ C 115, 19.4.2012, p. 1–28.

Figure 1: Outline of the intervention



The EPBD recasts the previous Directive 2002/91/EC by introducing new aspects while keeping, and in some cases reinforcing, the objectives, scope, principles and several provisions of the original Directive.

The recast had the following specific objectives:

- Provide a simple and unambiguous legal framework that will provide clear guidance and ease the transposition and implementation of Directive 2002/91/EC;
- Ensure that the policy instruments used stimulate further energy savings;
- Ensure that the measures have a wider coverage of the EU buildings stock and relevant energy consumption but are at low additional cost;
- Ensure that buyers/tenants/owners receive good quality information at a reasonable cost on the energy performance of buildings and about the performance of their heating and air-conditioning systems;
- Establish a base for cost-effective energy performance requirements for buildings or for their comparison;
- Stimulate the public sector to show good example in buildings' energy efficiency.

The EPBD has continued a trend towards a more holistic approach for a more efficient energy use in the building sector. The integrated approach is crystallised in the common general framework for the calculation of energy performance of buildings annexed to the EPBD, encompassing, in addition to the quality of insulation of the building, heating installations, cooling installations, energy for ventilation, lighting installations, position and orientation of the building, heat recovery, active solar gains and other

renewable energy sources. The choice of an integrated approach was explained in the explanatory memorandum of the original Commission's proposal[15] in 2001, which remains relevant today.

As regards elements reinforced with the recast, an effort was made to ensure the continued implementation of Directive 2002/91/EC by keeping its main provisions as they were already delivering.

More specifically, the recast introduced the following new provisions that did not exist in Directive 2002/91/EC:

- Several new definitions, including the concept of major renovation, multiple references to renewable energy sources and the framework definition of nearly zero-energy buildings;
- Article 5 on the calculation of cost-optimal levels of minimum energy performance requirements;
- Article 8 on technical buildings systems;
- Article 9 on nearly zero-energy buildings (NZEB);
- Article 10 on financial incentives and market barriers;
- Article 16 on reports on inspection of heating and air-conditioning systems; and
- Article 18 on independent control systems and Article 27 on penalties, which in combination provide for the establishment of enforcement mechanisms.

In addition, the Directive reinforced significantly the following provisions:

- Article 6, by requiring that the assessment of technical, environmental and economic feasibility of high-efficiency alternative systems such as decentralised energy supply or district solutions is documented and available for verification purposes;
- Article 7, by removing the 1000 m² threshold for minimum requirements in existing buildings when they undergo major renovation;
- Articles 11 to 13 on energy performance certification systems, in particular as regards having recommendations adapted to the specific building and public buildings to lead by example through the display of energy performance certificates (EPC); and
- Article 14 on inspections on heating systems by enlarging the scope of obligations to regularly inspect boilers to the inspection of all accessible parts of the heating systems.

The intervention logic and a more detailed description of the main provision of the EPBD can be found in Annex 3.

[15] *"With today's highly insulated new buildings and the trend towards low energy houses, these additional factors play an increasingly large role and should therefore be included in regulatory provisions. Such an integrated approach will give more flexibility to designers to meet energy reduction standards in the most cost-effective way. […] A common approach on this basis would contribute to a more level playing field as regards the efforts made by Member States to achieve energy savings in the buildings sector. It would also facilitate the comparison of buildings throughout the EU for prospective users and make it easier for designers and constructors to apply standards in other Member States."*, COM(2001)0226 final of 15 May 2001, proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings.

By building on the structure and provisions of the Directive 2002/91/EC, as well as the implementing measures already undertaken by Member States, the transposition of the EPBD was expected to be eased, whilst at the same time tapping a larger share of the energy saving potential and other related benefits.

The recast intended to facilitate transposition and implementation. The Impact Assessment[16] estimated the minimum total impacts as follows:

- 60 – 80 Mtoe/year energy savings by 2020, i.e. a reduction of 5-6% of the EU final energy consumption in 2020;
- 160 to 210Mt/year CO_2 savings by 2020, i.e. 4-5% of EU total CO2 emissions in 2020;
- 280,000 (to 450,000) potential new jobs by 2020, mainly in the construction sector, energy certifiers, auditors and inspectors of heating and air-conditioning systems.

During the Impact Assessment preceding the EPBD, based on the 2007 update of the PRIMES reference scenario[17], the EU wide cost-effective energy efficiency potential was estimated at 28% cost-efficient energy savings by 2020 for the sector (or 143 Mtoe final energy), which is equivalent to 11% of total EU final energy consumption in 2020.

3. EVALUATION QUESTIONS

The evaluation addresses specifically the following questions.

Effectiveness

- To what extent has the Directive achieved its objectives, e.g. to improve the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness?
- Which provisions have been most appropriate for improving energy performance of buildings? To what extent has the lack of fixed EU-wide levels (requiring instead that Member States lay down the mechanisms for implementing its provisions) been effective and why?
- What main factors, in particular related to national implementation, have influenced, or stood in the way of, achieving these objectives?
- What results, if any, did the EPBD achieve beyond its main aim to promote energy performance, for example towards job creation or retention, incorporation of renewable energy sources in buildings or driving innovation in building-related technology?
- Did the Directive cause any other unexpected or unintended changes?

Efficiency

- What are the costs and benefits associated with the implementation of the EPBD?
- To what extent have the EPBD and the obligations included therein been efficient means of achieving a more energy efficient European building stock?
- To what extent are the costs involved with implementing the EPBD justified given the benefits which have been achieved?

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16 Communication Staff Working Document of 13 November 2008 accompanying the proposal for a recast of the EPBD – Impact assessment SEC(2008)2864

17 European energy and transport trends to 2030, update 2007, European Commission (written by E3M-Lab)

- Is there potential to simplify and deliver the objectives of the Directive more efficiently? How?
- Have there been technical or other developments since the elaboration of the Directive that could contribute to achieving the objective more efficiently, for example in the context of the recent EEFIG report[18]?
- To what extent does the Directive allow for efficient policy monitoring (e.g. reporting mechanisms)? How far do the reporting processes allow for efficient collection of all relevant information?

Relevance

- Do the EPBD objectives still correspond to the needs of the policy area concerned?
- To what extent have the EPBD objectives proved relevant to the needs identified at the outset?
- Which other approaches than those set currently in the EPBD became more important for improving energy efficiency in buildings, including solutions at district and city levels?
- What are citizens' expectations for the role of the EU to ensure an efficient building stock?

Coherence

- To what extent are the EPBD provisions internally coherent? Do provisions overlap or contradict, do they co-act as intended?
- Does the EPBD contradict other EU interventions with similar objectives?
- To what extent can effects be linked to provisions in other EU legislation?
- Which effects had the EPBD on areas targeted by other EU legislation?
- To what extent are there any gaps between the EPBD and other relevant EU legislation or initiatives that could prevent the objectives of the EPBD to be met?

EU added value

- What has been the EU added value of the Directive, and do the issues addressed continue to require action at EU level?
- Why would the EPBD objectives be better achieved by EU action?

4. METHOD

4.1. Sources of information

Following the Evaluation Roadmap published in July 2015[19], the evaluation has been carried out on the basis of information and data collected from different sources.

Stakeholders were consulted through an open internet-based public consultation that ran from 30 June 2015 to 31 October 2015 and thematic technical workshops on specific topics took place from June 2015 to January 2016.

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18 Energy Efficiency Financial Institutions Group, "Energy Efficiency – the first fuel for the EU Economy. How to drive new finance for energy efficiency investments", February 2015, www.eefig.eu

19 http://ec.europa.eu/smart-regulation/roadmaps/docs/2016_ener_023_evaluation_energy_performance_of_buildings_directive_en.pdf

Different studies supported the monitoring of the implementation of the Directive and provide relevant input to this evaluation. When the findings of these studies are used in the current evaluation, reports are explicitly referenced.

A specific study for the evaluation of the application of the EPBD and assessment of policy options and resulting energy related impacts in the framework of the EPBD review delivered the summary report following the public consultation[20] and informed the present evaluation.

Information on the implementation of the EPBD is also available from the work of the EPBD Concerted Actions and, according to the terms of Article 19 of the EPBD, the work of the Energy Performance of Buildings Committee.

In addition to the consultation activities involving the European Commission, this evaluation made use of other sources of information, e.g. research papers, identified through literature review. When such sources of information are used in the current evaluation, they are explicitly referenced.

The Secretariat General (SG) has set up an ISG on the review of the EED, the EPBD and the *'Smart Financing for Smart Buildings'* initiative. The group met in total nine times in support of the full review process, from 30 April 2015 to 28 June 2016.

More information on the consultation with stakeholders and the external expertise used for the evaluation is provided in Annex 4.

4.2. Regulatory scrutiny board

The draft evaluation was submitted to the scrutiny board on 2 March 2016.

The regulatory scrutiny board met on the 6 April 2016 and issued an opinion which supported further improvement of the evaluation report with respect to the following key aspects:

(1) The assessment of coherence should be improved and conclusions supported with evidence. In doing so, the report should better explain the scope, the policy context and the coherence with other energy efficiency initiatives and evaluations. It is sensible that a fitness check of the Directive (together with other related instruments) be undertaken in the next round of the policy cycle to explore better the coherence between different but related policy instruments;

(2) The report should clarify the effectiveness of the Directive in reaching its policy objectives, in particular those specified in the 2008 Impact Assessment. To what extent can the available evidence be used to attribute energy savings in the buildings sector to this directive as opposed to other instruments such as financing instruments, the energy efficiency directive and the effort sharing decision etc.;

(3) The evidence supporting the efficiency assessment of the Directive should be better demonstrated, in particular regarding the cost-effectiveness. In this context, the report should explain upfront any limitations and justify them;

[20] Public Consultation on the Evaluation of the EPBD – Final synthesis report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

(4) In view of the envisaged impact assessment, the reasons behind the slow progress in the area of building renovations should be better elaborated as well as those aspects of implementation which have been found to be problematic;

(5) The lack of available data should be explained, including clarifications on how the problem will be dealt with in the future. The report should be shortened and streamlined, in order to fulfil the Better Regulation guidelines requirements.

The Evaluation was redrafted in response to the Board recommendations, which are addressed by reducing the number of pages of the main report and further elaborating the following sections:

(1) Section 6.4 and Annex 12;

(2) Section 6.1 and Annex 9;

(3) Section 6.2 and Annex 10;

(4) Sections 5.3 and 6.2;

(5) Section 5.2.

The Annexes have also been reformulated to contain all background information and supporting evidence to the findings presented.

4.3. Robustness

Although the review of the EPBD comes arguably early in the life of the Directive, its scope, objectives, and some core provisions already existed in Directive 2002/91/EC. There is therefore more experience with transposition and implementation than the transposition date of July 2012 and the application date of January 2013 seem to suggest. Moreover, the EPBD Concerted Action has accumulated more than ten years of practical experience on national implementation of the Directives and compiled numerous best practices. As of 2016, the Concerted Action has produced two detailed reports on national and EU-wide lessons from the transposition and implementation of the EPBD.

The present evaluation made use of the most recent sources of information. However, the granularity and level of quantification in the analysis of impacts of the EPBD is substantially constrained by the availability of quantitative data.

Global annual energy data for 2014 were published by Eurostat only very recently (9 June 2016) and there is limited available data on disaggregated energy consumption in the households sector and in the services sector. It is therefore not possible, for the years 2014 and after, to segregate the specific effect of the EPBD on energy consumption from other influencing factors such as climate variations, economic activity, behaviour, etc.

This lack of reliable and consistent data is seen as a major challenge and was already identified as a limitation when carrying out the Impact Assessment for the EPBD[21].

For the residential sector, the final energy consumption in households and its disaggregation per fuel are currently used by Eurostat as proxy indicators in the key

[21] Communication Staff Working Document of 13 November 2008 accompanying the proposal for a recast of the EPBD – Impact assessment SEC(2008)2864

area 'Improving buildings' of the resource efficiency initiative[22]. More detailed data on energy consumption in households (e.g. energy for space heating, space cooling, water heating and cooking) will be collected in the future under the Commission Regulation (EU) No 431/2014 of 24 April 2014 amending Regulation (EC) No 1099/2008 of the European Parliament and of the Council on energy statistics, as regards the implementation of annual statistics on energy consumption in households. The first reference year for mandatory reporting under this Regulation will be 2015. In 2014, only 12 Member States have voluntarily reported data.

For the non-residential sector, most available data cannot be considered to have the same quality grade as official statistics[23].

Regarding costs and benefits of the measures adopted pursuant to the EPBD, quantitative analysis was constrained by the available scattered information. The following evaluation of this specific aspect is therefore chiefly based on a qualitative analysis, cross-checking information from different sources and in particular from the public consultation and the specific consultation of Member States.

Nevertheless, the cost-benefit of measures is expected to be balanced thanks to the strong link between the provisions of the EPBD and cost-optimality, while leaving some flexibility in this respect:

- Member States are not required to set minimum energy performance requirements which are not cost-effective over the estimated economic lifecycle,
- Member States can set up criteria to exempt the application of minimum energy performance requirements for buildings and building elements, when this is not technically, functionally and economically feasible,
- Member States can opt to adopt equivalent measures to the regular inspection of heating and air conditioning systems.

Combined with the additional information collected under the above-mentioned Commission Regulation (EU) No 431/2014, the EU Building Stock Observatory, currently under development by the European Commission should significantly improve the situation and be an essential tool for monitoring and steering the improvement of energy efficiency in buildings and to support the implementation of the EPBD.

5. CURRENT SITUATION

5.1. State of implementation

Full implementation and strict enforcement of existing energy and related legislation is the first priority to establish the Energy Union. As highlighted by the 2016 Annual report on monitoring the European Union law[24], the Commission closely monitors the application of the acquis in the climate and energy policy areas. It undertook systematic checks on Member States' transposition of, and conformity with the EPBD.

[22] Eurostat data code "t2020_rk200 - Final energy consumption in households" and data code "t2020_rk210 - Final energy consumption in households by fuel"

[23] Robust building data: A driver for policy development, 2013, GBPN

[24] 33rd Annual Report on monitoring the application of EU law (2015); COM(2016) 463 final of 15 July 2016.

EU Pilot dialogues and infringement procedures are systematically launched for non-compliance with the EPBD, with positive outcomes. Despite these efforts, correct transposition is not yet ensured for all provisions and countries. Discussions on conformity issues are still necessary and going on. These activities and their results are detailed in Annex 5.

Beside these legal enforcement activities, the European Commission established a joint initiative with representatives from the national implementation bodies in order to enhance the sharing of information and exchange of experiences from national adoption and implementation. Since 2005, the Concerted Action EPBD has been the technical forum for national representatives working on the transposition and implementation of the EU directive into national measures and policies.

Evidence shows that the Concerted Action has substantially contributed to a better understanding of the implementation challenges and the pro and cons of various strategies to implement the EPBD requirements in a cost effective way into the national context of Member States. The latest report of the EPBD Concerted Actions[25] gives an overview of the achievement in five thematic and describes the status of implementation in all 28 Member States plus Norway.

5.2. Energy trends

The EU Reference scenario 2016 (REF2016)[26] constitutes the latest projections for EU and Member States energy, transport and greenhouse gas (GHG) emission-related developments up to 2050. It does so by taking into account global and EU market trends and the energy and climate policies already adopted by the EU and its Member States, including the EPBD.

According to REF2016, total 2020 final energy consumption in the residential and tertiary sectors would be 485 Mtoe, instead of the 541 Mtoe projected by the baseline 2007 update of the PRIMES reference scenario, i.e. a 56 Mtoe reduction of final energy consumptions for these two sectors, close to 60-80 Mtoe total impacts expected out of the recast.

REF2016 indicates that the distribution of final energy consumption across sectors will remain broadly identical, keeping with around 40% of the final energy consumption for these two sectors.

This reference scenario confirms that electrification is a persisting trend, due to a growing electricity demand, the electrification of heating (heat pumps) and, to a limited extent, the electrification of the transport sector.

In parallel, the share of electricity generation from renewable energy in total gross electricity generation increased from 14.4 % in 2004 to 27.5 % in 2014[27]. In the future, the EU power generation mix is expected to keep changing considerably in favour of renewables.

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25 Implementing the Energy Performance of Buildings Directives, 2016, Concerted Action EPBD

26 EU Reference Scenario 2016 – Energy, transport and GHG emissions – Trends to 2050, 2016, European Commission.

27 Eurostat, ref. indicator "nrg_ind_335a"

For 2020, the reference scenario reports a total primary energy decrease by 18.4% (relative to the 2007 baseline), still falling slightly short of the 2020 indicative EU energy efficiency target of 20%.

5.3. Broader context interfering with the EPBD impact

It should be noted that these results are achieved with worse economic conditions than the underlying assumptions of the 2007 reference scenario. This scenario, used as reference for the 2008 Impact Assessment proved to be overestimated:

- The 2007 Primes scenario was 'pre-crisis' and assumed a 2.5% increase of GDP per year; and
- The rate of renovation was equally overestimated as influenced by the 'pre-crisis' scenario.

The EPBD, and in particular energy performance certificates and inspection reports, addresses informational barrier to create a demand-driven market. Under the EPBD, the decision to take action to upgrade the energy performance of buildings is entirely left to market actors. The minimum energy performance requirements set under the EPBD only apply when construction or renovation work is performed. The broader economic context plays a role in the magnitude of the impacts of the EPBD.

As shown in Annex 6, the construction sector was strongly hit by the global crisis with a decrease of economic output and absolute number of jobs. It has not yet fully recovered from it. As of May 2015 it was still 35% points below pre-crisis levels.

On the other hand, new business opportunities generated by EU energy efficiency legislation is estimated at some €124 billion over the 2010-2014 period, corresponding to about 5% of the total value of the residential building market[28]. This constitutes a meaningful contribution to sustain the level of activity during a difficult period for the construction industry, in particular towards SMEs. However, this was a period of low demolition rates (0.1-0.2% per year), limited new construction activities (0.4-1.1% per year) and very low refurbishment rates (0.4-1.2% per year).

With construction rate significantly higher than the demolition rates, the building stock is naturally expanding in size. This means more space to heat, cool, ventilate, etc. The increasing size is bound to increase its energy consumption and hence to the increase in energy related carbon-dioxide emissions.

At current construction and demolition rates around 70% of the buildings that will be in-use in 2050 are already built. This confirms that buildings are assets with a long lifetime, much longer than appliances, or cars.

As presented in Annex 7, at least 20-65 Mtoe of cost-effective saving potential in the residential and tertiary sectors remain untapped for 2020, 80-85% of which are within the scope of intervention of the EPBD. The tighter minimum energy performance requirements and high compliance rates of new buildings (typically above 80%)[29], mean that the large saving potentials remains mostly in the existing buildings stock.

[28] Supporting study for the Fitness Check on the construction sector: EU internal market and energy efficiency legislation, 2016, European Commission (Written by Economisti Associati, Milieu, CEPS, BPIE, DBRI)

[29] Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

Increasing the rate, quality and effectiveness of building renovation is certainly the biggest challenge for the coming decades.

The reason for the lack of uptake of cost-effective renovation can be found in the split incentives associated with tenure status, the general lack of understanding among households of their energy use, and potential savings related to different energy efficiency measures[30,31] as well as insufficient knowledge on financial and other benefits related to building renovation.

In this context, present investment flows in energy efficiency and renewable energy in buildings are below half of the investments needed[32]. Deep renovation of buildings requires significant up-front cost for building owner-occupiers, who represent 70% of the EU building stock. The capacity of households to pay for this up-front cost depends on their level of savings, income, debt capacity, credit worthiness, their access to public support schemes or other financing instruments and availability of attractive financing products on the market.

Such attractive financing products are missing, usually because financial institutions do not incorporate all the benefits of energy efficiency investments (higher asset value, better liquidity position of borrowers, lower credit default rate of renovation loans compared to standard loans) into their commercial offering.

Split incentives also play an important role. 30% of the EU population live as tenants, according to Eurostat. Landlords may have little incentives to invest in housing stock improvements as return on capital employed can be limited.

The above is also valid for the non-residential sector and in particular for SMEs. Financing mechanisms such as third party financing where repayments are partly funded by the energy savings over a long period are not affordable and practical for all. Split incentives are also present in office buildings and other rented space such as shopping malls. Split incentives are indirectly addressed by Article 7 of the EED, acting on the renovation rate (there are no specific provisions in the EPBD to address this issue).

In the public buildings segment, the level of investment financed through commercial finance (outside public finance grants) is influenced by Eurostat accounting rules and of Stability and Growth Pact rules on flexibility. Further, lack of capacity of public sector to aggregate small scale measures into larger scale investments across their buildings stock leads to suboptimal solutions, far below cost-effective potential.

On the use of private funding, the EEFIG identified the lack of aggregation of smaller building renovation investments (to decrease the transaction costs), and the perceived high risk as important barriers for building renovation.

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30 Public perceptions of energy consumption and savings. Procedings of the National Academy of Science of the USA. 2010

31 Domestic energy use and householders' energy behaviour. Energy Policy. 2012

32 DIW. (2013). Financing of Energy Efficiency: Influences on European Public Banks' Actions and Ways Forward. Retrieved from: http://hayek.diw.de/documents/publikationen/73/diw_01.c.422405.de/hudson_financing.pdf

5.4. Technological development

Combined with increasing energy prices, cost reduction of energy efficient solutions are key enablers to stimulate further the demand for energy efficient buildings. As shown in Annex 8, new technology developments and cost reduction of efficient technologies were observed since the adoption of the EPBD in 2010.

There is still a lot to be done to ensure the transformation of the EU building stock in a sustainable way, making buildings more energy efficient, in a value-chain and lifecycle perspective, improving the indoor environment and making an efficient use of resources[33]. The challenge is not limited to renovation, however. Barriers such as cost, quality of the works delivered[34], integration of renewable energy sources, and required construction skills[35] also hamper the development of new nearly zero-energy buildings. In addition, increasingly sophisticated building control, automation and monitoring systems require better interoperability and effective integration within the building and the surroundings (e.g. energy grids, district infrastructure).

Technological progress towards 'smarter' building systems creates enabling conditions to provide information to consumers on operational energy consumption[36]; to adjust to the needs of the user; to run the efficient and comfortable operation of the buildings; its readiness to connect to electric vehicle charging, to host energy storage and to support demand response in an modernised electricity market.

6. ANSWER TO THE EVALUATION QUESTIONS

This section summarises the answer to the evaluation questions presented in Section 3. Detailed analysis for each of the below Sections 6.1 to 6.5 can be found in their respective Annexes 9 to 13.

6.1. Effectiveness

Although saving potential remains high (Annex 7), positive effects of the EPBD are observed as follow (Annex 9).

Up to 2014, 48.9 Mtoe energy savings have been achieved in total:

- 41.4 Mtoe in the residential sector (of which 36.6 Mtoe for space heating only),
- 7.5 Mtoe in the service sector.

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33 Energy-Efficient Buildings – Multi-annual roadmap for the contractual PPP under horizon 2020, 2013, European Commission (E2B/ECTP)

34 IEE project QUALICHECK is investigating issues affecting quality of the building works with regard to energy performance and is developing appropriate guidance, with a focus on four key technologies (Transmission characteristics, Ventilation and airtightness, Sustainable summer comfort technologies, Renewables in multi-energy systems). See: QUALICHeCK 'Quality of the Works' report: http://qualicheck-platform.eu/2015/02/report-quality-of-the-works/

35 The BUILD UP Skills initiative under IEE aims to increase the number of qualified workers across Europe to deliver renovations offering a high energy performance as well as new, nearly zero-energy buildings. See: http://www.buildupskills.eu/

36 Building energy management systems allow savings in existing buildings arising from a more efficient operation of space heating in the range of 2-30% and for cooling 37-73% depending on the climate and building type (Improving energy efficiency via smart building energy management systems: A comparison with policy measures. Energy and Buildings. Volume 88, 1 February 2015, Pages 203–213)

These figures seem to be in line with the 2008 Impact Assessment supporting the adoption of the EPBD and indicate that the Directive is likely to deliver the expected 60–80 Mtoe energy savings by 2020.

On average, the final energy consumption per square meter is still very high (final energy consumptions of 175kWh/(m².year) for residential buildings and around 300kWh/(m².year) for non-residential buildings) and decreasing very slowly, by 3.8kWh/(m².year) in the household sector, 5.2kWh/(m².year) in the service sector.

After 2006, application date of the Directive 2002/91/EC, a clear positive change of trends in the energy performance of buildings (primary energy consumption per square meter) is observed. This observation varies across Europe. The few Member States where an opposite change is observed had already a quick improving energy performance before 2006.

Furthermore, the EPBD was the main responsible agent for important improvements in energy performance of buildings in the EU:

- Directive 2002/91/EC and the EPBD resulted in major modernisation of national building codes through the introduction of minimum requirements for existing buildings and the cost optimality concept, followed by the adoption of nearly zero energy standards;
- Prior to the EPBD, few Member States fixed their levels of minimum performance requirements based on cost-optimal solutions and, as a result of the EPBD, a strengthening of minimum energy performance requirements in building codes is observed[37].

The share of renewable energy in final energy consumption is steadily increasing, with a significant contribution of small scale on-building installations. The 2014 share of renewables in final energy consumption in residential and service sectors is estimated at 20.3% (9.3% is renewable electricity plus 11.0% from other renewable sources).

Over the same 2007-2013 period of time, direct GHG emissions were reduced by 63 Mt CO_2 (i.e. 8% of the 1990 emissions of household and service sector).

720,000 direct and indirect jobs, mainly in SMEs, can be associated with the energy renovation of the EU building stock, including 148,800 jobs created or maintained thanks to new business opportunities generated by EU energy efficiency policies.

With the available data it is not yet possible to conclude on the additional effect of the recast. However, there are still potential improvements to be expected with a continued and proper implementation of the EPBD:

- should the national/regional calculation methodology for the energy performance of building be unbiased and considering fairly all technologies that can contribute to the improvement of the energy performance of buildings, in particular emerging efficient technologies, including technologies using renewable sources;
- should minimum requirements be periodically reviewed and the calculated cost-optimal level be swiftly implemented in the national/regional legislation. The

[37] Assessment of cost-optimal calculations in the context of the EPBD, 2015, European Commission (written by Ecofys)

EPBD leaves 5 years (*"by the next review"*) to reduce any significant gap between the regulatory and the cost-optimal levels[38];

- should Member States take the relevant actions to ensure that by 2019 (public buildings) and 2021 (privately-owned buildings) all new buildings placed on the market will effectively be nearly zero-energy buildings (NZEB)[39];
- should enforcement and compliance of the EPBD be stronger. Levels of compliance with national transposition measures hamper reaping a potential of around 40% additional energy savings, mainly because of lack of compliance with minimum requirements in existing buildings[40];
- should the measures adopted to further catalyse the increase in energy performance of buildings prevent lock-in effects or other negative effects.

It is impossible to precisely segregate and quantify a specific contribution of the EPBD to the above achievements:

- As developed in Section 5.3 above, the EPBD and the broader economic context and the action taken by the EU and by Member States to improve this context have intermingled effects;
- Other EU policies working in synergy with the EPBD may have influenced the observed trends, e.g. national measures including those adopted pursuant Directive 2006/32/EC on energy end-use efficiency and energy services. On the other side, by requiring the setting of minimum standards, the EPBD is also having an influence on the effectiveness of these other measures.

This last observation is equally valid for the specific parts of the EPBD. Section 6.2 on efficiency will show the value to consider the EPBD as a whole rather than as a set of interventions.

6.2. Efficiency

For the public sector, the Concerted Action estimated the administrative costs supported by Member States to transpose and implement the EPBD in the 2011-2015 period (staff, studies, communication campaigns) at 160.8 M€ in total, reasonable in comparison with the benefits associated with the achievements of the EPBD.

For the private sector, the consultation with stakeholders[41] indicates that the processes created by the EPBD are necessary, in the light of the energy saving potential in the buildings sector.

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38 Report from the Commission to the European Parliament and the Council – Progress by Member States in reaching cost-optimal levels of minimum energy performance requirements; COM(2016)464 final of 29 July 2016.

39 Commission Recommendation (EU) 2016/1318 of 29 July 2016 on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero-energy buildings; OJ L 208, 2.8.2016, p. 46–57.

40 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

41 Public Consultation on the Evaluation of the EPBD – Final synthesis report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

The EPBD creates the conditions for the better information of decision makers. This is generally done through three main instruments, which efficiency can be summarised as follow:

- The energy performance certification of buildings have a relatively limited additional transaction cost (in the range of 85-140€ for an apartment or single family house EPC[42], i.e. around 1€/m², valid for 10 years). EPCs have positively influenced property valuation, both for the sale and rental market[43], hence effectively contributing to the creation of a demand driven market for energy efficiency in buildings;
- The regular inspection of heating and air-conditioning systems are reported to have a relatively low cost, 200€ on average for both types of inspections;
- Little information could be gathered on the cost of the technical, environmental and economic feasibility of high-efficiency alternative systems, mandatory before any new construction starts. It is however estimated around the cost of an EPC, i.e. 1€/m²;

No regulatory cost can be associated to minimum energy performance requirements. The EPBD does not mandate any construction or renovation activity. When the decision to build or renovate a building is taken, the EPBD prevents sub-optimal investments by prescribing minimum requirements based on cost-optimality.

The choice of a cost-optimal benchmarking methodology to steer existing national energy performance requirements towards cost-efficient levels has proved to be an efficient and results-oriented approach. The cost-optimal calculations allowed the identification of cases where there is still a significant potential for cost-effective energy savings. On the other hand, the analysis of the first cost-optimal calculations[44] showed that some Member States took the political decision of setting minimum requirements more stringent than the cost-optimal levels, possibly because of the non-economic benefits of improved building energy performance, which are not integrated in the framework calculation methodology[45].

In this respect, the provisions of the EPBD leave flexibility to avoid overly burdensome situations:

- Member States are not required to set minimum energy performance requirements which are not cost-effective over the estimated economic lifecycle,
- Member States can set up criteria to not apply minimum energy performance requirements on a case-by-case basis, when this is not technically, functionally and economically feasible.

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42 http://www.viadiagnostic.fr/tarif-diagnostic-immobilier.html. Lower prices below 50€ are also observed on the market. It is however considered that such prices hardly leave the time to provide tailor made recommendation that could be trusted and taken up by building owners.

43 Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries, 2013, European Commission (written by Bio Intelligence Service)

44 Report from the Commission to the European Parliament and the Council – Progress by Member States in reaching cost-optimal levels of minimum energy performance requirements; COM(2016)464 final of 29 July 2016.

45 Commission Delegated Regulation (EU) 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements

There is evidence[46] showing that renovation decisions are made to meet the demands of domestic life and triggered by exogenous factors (e.g. a boiler breaking down, humidity in a wall), which precipitate an immediate response on the affected building element. Such patchy intervention could be seen as a factor that limits the effectiveness of the Directive. Nevertheless, lowering the major renovation threshold would not be an appropriate answer as it would be burdensome and not easy to enforce. The Directive has proved to take a balanced approach to the issue. The evaluation identified a need to ensure that step by step upgrades follow consistent intervention logics over time. This need was highlighted by many respondents to the public consultation[47] but could be addressed by high quality recommendations on the EPCs and a reference to these recommendations when financial support is granted.

It has been found that national implementation of the Directive could be more efficient in several cases:

- 35 different national/regional calculation methods for the energy performance of buildings, lacking of transparency, contribute to market fragmentation, limiting cost reduction potential for existing technologies and development of new ones (e.g. integration of renewable energy technologies in buildings)[48]. In total, half of the Member States have a different calculation method for setting and ensuring minimum energy requirements, on the one hand, and for certifying buildings on the other hand[49]. Such implementation choices create complexity and limit the readability of the policy for end users;
- The provisions related to nearly zero-energy buildings will fully operate as from January 2021 (January 2019 for public buildings). However, this perspective is perceived by the respondents to the public consultation as an important signal. Mobilising stakeholders towards a common path is expected to make NZEB levels correspond to the cost-optimum level for 2020. To ensure that this actually happened, the Commission recently issued a Recommendation[50];
- The calculated cost-optimal levels can be implemented by Member States within 5 years after the calculations were carried out. When minimum requirements are implemented, these are generally enforced at building permit stage, which means that buildings can be built with the standards into force at the time of granting the permit. This time lapse, compliance and enforcement gaps[51] are contributing to not reaching cost-optimal levels are leaving room for sub-optimal investments;
- Even if EPCs have positively influenced property valuation, EPC recommendations could have had a higher impact on informing and stimulating higher renovation rates. For certification to go beyond its main objective of giving a market signal for efficient buildings and equally stimulate more building renovation, EPCs should be

46 Applied behaviour research on households' attitudes towards building renovation (C. Wilson et al. / Energy Research & Social Science 7 (2015))

47 Public Consultation on the Evaluation of the EPBD – Final summary report, 2015, European Commission (written by Ecofys).

48 Technical assessment of national/regional calculation methodologies for the energy performance of buildings, 2015, European Commission (written by CSTB/TSUS)

49 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

50 Commission Recommendation 2016/1318 of 29 July 2016 on guidelines for the promotion of nearly zero-energy buildings and best practises to ensure that, by 2020, all new buildings are nearly zero-energy buildings; O.J. L208, 2.8.2016, P46-57.

51 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

better integrated within a framework of supporting measures including EPC databases[52], and stronger links to financing schemes and to compliance checking. For instance, the study on compliance[53] indicates that EPCs can be a valuable tool for assessing the level of compliance with building codes and enable efficient compliance check by providing information to central bodies;

- The public consultation indicated that, in their current form, inspection reports could be poorly suited to the needs of non-expert building owners, with a high risk for the recommendation therein of being ignored. Under the EPBD, Member States can make many different choices when deciding how to implement regular inspections and have taken advantage of this flexibility. Thirteen of them have chosen alternative measures in place of inspection of heating systems. Seven of them have chosen alternatives to air-conditioning inspection, this being a new option available with the recast. According to the Concerted Action, alternatives to inspection are chosen by Member States who consider that physical inspection is too expensive relative to the likely benefits, or is unworkable for other reasons. Moreover, technology developments related to building automation, electronic monitoring and smart metering have the potential to find energy saving opportunities more cheaply and effectively than regular inspection[54]. These could also prepare buildings' full interaction with the energy system.

Enhanced efficiency is achievable through more holistic ways to implement the Directive, giving more clarity to the overall system and reducing the administrative burden to ensure compliance, in particular for existing buildings. Such approaches are already in application in some Member States, for example:

- The setting of minimum requirements according to EPC energy classes that enable the use of EPCs to ensure compliance and a monitoring of the building stock through a central EPC database;
- The involvement of other actors in the checking process (e.g. notaries for the handover of EPCs including for the rental agreement which practically ensures 100% compliance, installers for the declaration of performance of the retrofitted building elements);
- Appropriate accompanying measures such as a more systematic link between EPCs and financial support, e.g. with an ex-ante and ex-post energy performance rating to set and check the appropriate level of financial support, or linking cost effective recommendations in EPCs to mortgage options.

This can only be the case with robust energy performance certification schemes. Although reinforced by the EPBD, limited progress as regards the independent quality control of EPCs and inspections can be observed[55]. After surveying the Member States in March 2014, the Commission services observed that too small samples were randomly checked in most Member States to derive any conclusion on the quality of EPCs and inspection reports.

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52 In 2014, 24 Member States had an operational regional of national EPC database (plus Norway). In addition, Poland, Latvia, Luxembourg and the Czech Republic are lining up to launch their own databases.

53 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

54 Electronic monitoring systems can deliver on the same objectives, in real time (e.g. iServCMB project)

55 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

The need for a holistic implementation is equally valid for the national long-term renovation strategies developed under Article 4 of the EED. The assessment of the strategies[56] revealed that in most cases Member States merely reported a reference to the cost-optimal methodologies but did not integrate the results within the strategy. The use of national EPC databases to link EPCs with financing schemes and contribute to better enforcement of building provisions was generally lacking.

6.3. Relevance

The EPBD is needed to achieve EU ambition and its general objective, framework and boundary conditions remain relevant.

The European building stock is responsible for approximately 30% of the EU greenhouse emissions[57] and 40% of the final energy consumption[58]. The sector is expanding, which is bound to increase its energy consumption. Therefore, reduction of energy consumption and the use of energy from renewable sources in the buildings sector constitute important measures needed to reduce the Union's energy dependency and greenhouse gas emissions. Energy trends indicate that final energy consumption for the households and service sector will remain around 40% in the coming decades.

According to the Communication on the state of the Energy Union[59], there are still numerous barriers to reaping the full potential of energy efficiency, such as information failures and a shortage of dedicated financial tools. This leads to a limited uptake of energy efficiency opportunities, products and technologies.

For buildings, saving potentials mostly lays within the current EPBD scope (space and water heating, space cooling, ventilation and their auxiliary, and lighting in the non-residential sector), to a very large extent in the existing building stock.

The general mechanisms of the EPBD are relevant to address saving potentials

The transposition of the EPBD into ambitious building codes in the Member States is and will continue to help Member States to reach their GHG reduction targets for the non-ETS sector under the Effort Sharing Decision (ESD).

Better energy performance of buildings can deliver social co-benefits as a result of enhanced usability of the building, more efficient use of resources, enhanced health and quality of life, stimulating economic recovery and promoting growth and the creation and retention of jobs[60].

The district-scale is an attractive option due to the higher leverage factor of any intervention at this scale. But challenges and barriers are aggravated when scaling up

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56 Synthesis Report on the assessment of Member States' building renovation strategies, 2015, European Commission (JRC)

57 In 2014, the share of inland GHG emissions for Commercial/Institutional/Residential sectors and 60% of the Public Electricity and Heat Production sector (without LULUCF and without international aviation and international maritime transport) was 31.7%. Source: EEA/UNFCC.

58 In 2014, households and services were accounting for 38.1% of the final energy consumptions. Source: Eurostat.

59 Communication from the Commission - State of the Energy Union 2015, COM(2015) 572 final of 18 November 2015.

60 Multiple benefits of EE renovations in buildings, 2012, Copenhagen Economics

from building to district. If there is space for the consideration of energy in the urban planning, there is no strong argument to change the current intervention.

There are however three aspects where the EPBD is not yet fully delivering on the identified needs: (i) better informing the financial institutions to improve the efficiency of the financial support; (ii) making more explicit that high energy performance in buildings requires both energy efficiency and renewable energy measures; and (iii) taking better advantage of the technological progress for the decarbonisation of the economy.

Options to address these three aspects should be analysed in the Impact Assessment.

6.4. Coherence

The EPBD is coherent internally and with other EU objectives and interventions.

6.4.1. Internal coherence

No internal contradiction could be identified during the evaluation. The provisions related to the setting of minimum requirements for new and existing buildings, the provisions for EPCs and inspections, and on more general measures to address market barriers, are focusing on different and complementary aspects. These provisions support each other. However, as indicated in the section on efficiency, related national implementation measures are not always co-acting as expected.

6.4.2. External coherence

The EPBD and other relevant EU legislation are found work in synergy:

- The objective of the EPBD to support the increase of building renovation depth and rates is supported by other EU legislation; *inter alia*, by the EED and by the European Structural Investment Funds (ESIF);
- The obligations arising from the EPBD to set and ensure minimum energy performance requirements for building elements, on the one hand, and the EU legislation on ecodesign and energy labelling energy efficiency of products, on the other hand, were found coherent;
- The provisions of the EPBD naturally drive the use of renewable energy sources, consistently with Directive 2009/28/EC;
- To achieve the 40% reduction target for greenhouse gas emissions in 2030, established in line with the cost-effective pathway described in the 2050 Roadmaps[61], the non-ETS sectors (buildings, transport and agriculture) need to cut emissions by 30% (compared to 2005). The improvement of the energy performance of buildings is key to achieve the 2050 target of at least 80-95% reduction requires that the residential and tertiary sectors together reduce their CO_2 reductions by 88 to 91% (compared to 1990 levels)[62];
- To mutually reinforce other EU policies. E.g. the EPBD and Directive 2014/61/EU[63] (in particular Article 8 *"In-building physical infrastructure"*) can be

[61] COM(2011) 112, COM(2011) 144 final, and COM(2011) 885 final

[62] A Roadmap for moving to a competitive low-carbon economy in 2050 (COM(2011) 112 final)

[63] Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 concerning measures to reduce the cost of deploying high-speed electronic communication networks

mutually supportive by creating respectively the demand and the offer for high-speed electronic communication networks.

6.5. EU added value

The principles of subsidiarity and proportionality were considered by the co-legislators and are explicitly mentioned in the recitals of the EPBD and were carefully respected. Article 194 of the Treaty on the Functioning of the European Union remains an appropriate legal basis of the EPBD.

Climate change, security of energy supply and environmental protection are challenges that cannot be sufficiently addressed at national level only. Energy efficiency and on-site renewables in buildings provide part of the solution of these problems and the instruments that have already been adopted at EU level reflect this need for EU action.

The EU level of intervention is crucial to address the challenge to transform the building stock and a proportionate level of harmonisation is justified and necessary:

- The impact assessment underpinning the non-ETS proposal demonstrated that in a cost-effective GHG reduction scenario for the EU, all Member States need to improve energy efficiency in a similar way and without an EU legislative instrument for buildings not all Member States would act (e.g. some can meet their Effort Sharing target without additional action). One or several Member States not acting in the area of buildings would imply overall higher GHG abatement costs for the EU as a whole;
- The Directive 2002/91/EC and EPBD played an important role to ensure that all Member States have energy efficiency requirements related to new and existing buildings in their building codes, based on cost-optimality. These minimum requirements are used in reference for the use of EU Funding under the Cohesion Policy and play an important role to ensure that EU funding is focused on the effective delivery of Europe 2020 objectives and targets;
- The setting of a pan-European ambition for all new buildings to be of nearly zero-energy by 2020 has proved to set a 'future-proof' vision for the sector and mobilise stakeholders accordingly. Similar market signals were found to be missing for the existing building stock, with the largest cost-effective potential.

Additional EU added value is brought through the support to national regulators; stimulating research and innovation at a higher scale; support to the single market integration for building products and services, including financial services to energy efficiency; and international leadership in the field of energy performance of buildings. In these areas, action at EU level offers a better leverage in mobilising the sector around a common ambition and offer higher expected market outcomes than in a fragmented market.

7. CONCLUSION

7.1. Key findings

The evaluation shows that the Directive is effective and is delivering on its general and specific objectives. Implementation to date shows broadly good performance on the other four analysed criteria: efficiency, relevance, coherence, and EU added value.

There is evidence of around 48.9 Mtoe of additional final energy savings in 2014 in buildings compared to the 2007 baseline of the EPBD. These savings occur mainly within the scope of the EPBD – space heating, cooling and domestic hot water – and a significant part can be attributed to factors influenced by policy interventions.

This figure of 48.9 Mtoe in 2014 is in line with the 2008 Impact Assessment supporting the EPBD, which estimated that the Directive would deliver 60 to 80 Mtoe of final energy savings by 2020.

The evaluation shows that the overall architecture of the Directive, combining minimum requirements and certification, is working, in particular for new buildings.

Targets for all new buildings to be of nearly zero-energy by 2020 have proved to set a *'future-proof'* vision for the sector and mobilise stakeholders accordingly.

Moreover, for both new and existing buildings, the choice of a cost-optimal methodology to steer existing national energy performance requirements towards cost-efficient levels has proved to be an efficient approach. Analysis of national reports shows that it is ensuring reasonably ambitious levels of requirements[64]. A large cost effective energy saving potential remains in the building sector (see Annex 7). Increasing the rate, quality and effectiveness of the renovation of existing buildings is the biggest challenge for the coming decades. The long term renovation strategies developed by Member States under Article 4 of the EED should result in increased renovation rates through mobilising finance and investments. These strategies should be combined in a clear forward looking vision with 2030 and 2050 perspectives, creating market signals for households, building owners/managers, businesses and investors.

The evaluation shows that certification of the energy performance of buildings is delivering a demand-driven market signal for energy efficient buildings and is achieving its aim to encourage consumers to buy or rent more energy efficient buildings. However, national certification schemes and independent control systems are yet at early stages in several Member States and their usefulness could be enhanced.

Due to the diversity and disaggregation of the buildings sector, it remains challenging to acquire good data on building characteristics, energy use, and financial implications of renovation in terms of cost savings or asset values. This lack of data has negative consequences on the market perception of the cost-effective energy saving potential of the EU building stock, on enforcement tracking, on monitoring and evaluation. EPC registers/databases can be a key instrument for reinforced compliance, improve the knowledge on the building stock and better inform policy makers and support the decisions of market players.

7.2. Scope for improvements

The evaluation identified ways in which national transposition and implementation can be further developed through better enforcement, compliance monitoring and evaluation.

[64] Report from the Commission to the European Parliament and the Council – Progress by Member States in reaching cost-optimal levels of minimum energy performance requirements; COM(2016) 464 final of 29 July 2016.

At EU level, opportunities for simplification or modernisation of outdated provisions and streamlining existing provisions in the light of technological progress were detected, in particular:

- The technical, environmental and economic feasibility of high-efficiency alternative systems, under Article 6(1)) of the EPBD. With the obligation for all new buildings to be nearly zero-energy buildings, the use of locally available high-efficiency alternative systems becomes an implicit obligation and this provision becomes an unnecessary burden;
- The regular inspection of heating and air conditioning systems, under Articles 14 and 15 of the EPBD, for which many Member States have opted out for alternative measures as allowed by the Directive.

Technological progress towards 'smarter' building systems offers not only opportunities to support a more efficient implementation of the EPBD and in addition creates enabling conditions: to provide information to consumers and investors on operational energy consumption; to adjust to the needs of the user; to run the efficient and comfortable operation of the buildings; to ensure buildings' readiness to connect to electric vehicle charging; to host energy storage; and to support demand response in a modernised electricity market.

In conclusion, the evaluation reveals relatively limited regulatory failures. There is however scope for simplifying and streamlining outdated measures, and for enhancing compliance through fine tuning of existing provisions and better linking them with financial support. Additionally the evaluation points to the scope for modernisation of the Directive in light of technological developments and the need to increase building renovation rates while supporting the decarbonisation of buildings in the long-term.

The results of this evaluation provide the basis for the Impact Assessment of policy options performed in the framework of the EPBD review.

Annex 1 ACRONYMS

CPR - Construction Product Regulation

EED - Energy Efficiency Directive

EPBD - Directive 2010/31/EU Energy Performance of Buildings Directive (recast), inclusive of the provisions kept from the Directive 2002/91/EC it recast.

EPC - Energy Performance Certificate

EnPC - Energy Performance Contracting

ESCOs - Energy Service Companies

NZEB - Nearly-Zero Energy Buildings

MS - Member States

TBS - Technical Building Systems

Annex 2 DEFINITIONS

Building: Buildings are roofed constructions that can be used separately and built for permanent purposes, which can be entered by persons and are suitable or intended for protecting persons, animals or objects (Eurostat, CC1998). The EPBD applies only to buildings with walls for which energy is used to condition the indoor climate (EPBD, Article 2(1)).

Building stock: All buildings from residential and services sectors (i.e. residential, and non-residential buildings).

Residential buildings: Buildings at least half of which is used for housing purposes. If less than half of the overall useful floor area is used for housing purposes, the building is classified under non-residential buildings in accordance with its purpose-oriented design. (Eurostat, CC1998). The residential building category can be further divided, e.g. depending on the ownership and the tenure status.

Non-residential buildings: Buildings which are mainly used or intended for purposes other than housing. If at least half of the overall useful floor area is used for housing purposes, the building is classified as a residential building. (Eurostat, CC1998). The non-residential building category can be further subdivided depending, e.g. on the nature of the occupant (public or private), the nature of the occupation (retail shops, etc.), the frequentation (visited by the public or not).

Building unit: Section within a building designed or altered to be used separately (e.g. an apartment in a multi-apartment block, a retail shop at the ground floor of a residential building).

Building product: Any product which is produced and placed on the market for incorporation in a permanent manner in building works or parts thereof and the performance of which has an effect on the performance of the building works with respect to the basic requirements for building works (Derived from CPR, Article 2(1)).

Building code: Set of rules regulating the basic requirements for building works in both new and existing building. Basic requirements may include requirements on: 1. Mechanical resistance and stability; 2. Safety in case of fire; 3. Hygiene, health and the environment; 4. Safety and accessibility in use; 5. Protection against noise; 6. Energy economy and heat retention; 7. Sustainable use of natural resources (Framework from CPR Annex 1).

Building envelope: Integrated elements of a building which separate its interior from the outdoor environment (EPBD, Article 2(7)). The elements that are part of buildings' envelope (wall, roof, glazed parts, etc.) generally consist of a system of building products separating the interior from the outdoor environment.

Building element: Either a technical building system or an element of the building envelope (Adapted from EPBD, Article 2(9))

Construction work: Buildings and civil engineering works (CPR, Article 2(3)).

Embodied energy: Total of all energy consumed in the processes associated with the production (and transport) of the materials and components that go into a building or structure.

Energy performance of a building: Amount of net primary energy needed to meet the different needs associated with its typical use and shall reflect the heating energy needs and cooling energy needs (energy needed to avoid overheating) to maintain the envisaged temperature conditions of the building, domestic hot water needs and built-in lighting. The energy performance of a building must be expressed in a transparent manner with an energy performance indicator and a numeric indicator of primary energy use (Adapted from EPBD Article 2(4) and Annex I).

Nearly zero-energy building: Building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources.

Major renovation: Building works of a certain cost (cost higher than 25% of the value of the building) or magnitude (affecting more than 25% of the surface of the building envelope) that provide a special opportunity to take cost-effective measures to enhance energy performance, beyond the simple retrofit of building elements.

Specific (primary/final) energy use: (Primary/final) energy use within the EPBD scope, space and water heating, space cooling, ventilation and lighting.

Energy performance of a building element: Performance related to energy for the integrated building element, expressed by level or class, or in a description

Technical building systems: Technical equipment for the heating, cooling, ventilation, hot water, lighting or for a combination thereof (EPBD, Article 2(3)).

Cost-optimal level: Energy performance level which leads to the lowest global cost during the estimated economic lifecycle. The cost-optimal level shall lie within the range of performance levels where the cost benefit analysis calculated over the estimated economic lifecycle is positive.

Annex 3 INTERVENTION LOGIC AND PRESENTATION OF THE INITIATIVE

1. Situation prior to Directive 2002/91/EC

Already in the 70's the first European energy policies intended to reduce the rate of growth of internal consumption[65] gave a prominent role to the building sector.

The building sector was one of the first sectors covered by two Council recommendations:

- The first[66], recommending minimum harmonized standards for the thermal insulation of new buildings, information campaigns and call for proposals to find cost-effective solutions to address existing residential buildings;
- The second[67], recommending the installation of temperature control devices for space and water heating systems in existing buildings, periodic maintenance and inspections, and heat metering.

These initiatives were regularly complemented but did not reach the expected level of implementation[68]. For example, in 1992, the recommendations and resolutions adopted by the Council on the billing of heating and hot-water costs had been applied in only two Member States[69].

In 1993, the SAVE Directive[70] aimed at stabilizing or reducing greenhouse gas emissions in 2000 at the 1990 level by requiring Member States to draw up and implement energy saving programmes, almost all related to buildings:

- energy certification of buildings,
- the billing of heating, air-conditioning and hot water costs on the basis of actual consumption,
- third-party financing for energy efficiency investments in the public sector,
- thermal insulation of new buildings,
- regular inspection of boilers,
- energy audits of undertakings with high energy consumption.

The "SAVE Directive" is reported to have had limited impact on energy efficiency due to its unusually large degree of flexibility and subsidiarity[71]. A complementary legal framework on energy efficiency, including specifically on buildings, was needed to lay down more concrete actions with a view to achieving the great unrealised potential for

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65 Community action programme on the rational utilization of energy of 27 November 1974 and Council Resolution of 17 December 1974

66 Council recommendation 76/492/EEC of 4 May 1976 on the rational use of energy by promoting the thermal insulation of buildings

67 Council recommendation 76/493/EEC of 4 May 1976 on the rational use of energy in the heating systems of existing buildings

68 COM(84)614 final of 13 November 1984, Towards a European Policy for the rational use of energy in the building sector.

69 COM(92)182 final of 20 May 1992, Proposal for a Council Directive to limit carbon dioxide emissions by improving energy efficiency (SAVE programme)

70 Council Directive 93/76/EEC of 13 September 1993 to limit carbon dioxide emissions by improving energy efficiency (SAVE), OJ L 237, 22.09.1993, p 28 – 30.

71 Report on the European Climate Change Program, June 2001, European Commission (JRC).

energy savings and reducing the large differences between Member States' results in this sector.

2. Directive 2002/91/EC on the energy performance of buildings

Directive 2002/91/EC was the first major policy initiative addressing energy efficiency in buildings. Its main purposes were to achieve the great unrealised potential for energy savings and reduce large differences between Member States' achievements in this sector.

The main objective of Directive 2002/91/EC was to promote cost-effective improvement of the overall energy performance of buildings within the Union, while taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness. The scope of the Directive encompassed energy needs for space and hot water heating, cooling, and lighting.

Directive 2002/91/EC covered energy used in residential and non-residential buildings for space heating, space cooling, ventilation, domestic hot water and built-in lighting (mainly in non-residential buildings). It therefore mainly targets the households and service sector. Other building categories (e.g. industrial buildings) or energy needs (e.g. electrical uses for appliances) are not covered.

Directive 2002/91/EC was a major step forward through which Member States introduced requirements based on a "whole building" approach. Directive 2002/91/EC defined, for the first time, the integrated energy performance of buildings. Accordingly, the indicator on building energy performance encompasses, in addition to the quality of insulation of the building, heating installations, cooling installations, energy for ventilation, lighting installations, position and orientation of the building, heat recovery, active solar gains and other renewable energy sources[72]. Directive 2002/91/EC also set up a general framework for a common methodology for national energy performance standards.

In the explanatory memorandum the Commission justified this approach as follows "*With today's highly insulated new buildings and the trend towards low energy houses, these additional factors play an increasingly large role and should therefore be included in regulatory provisions. Such an integrated approach will give more flexibility to designers to meet energy reduction standards in the most cost-effective way. […] A common approach on this basis would contribute to a more level playing field as regards the efforts made by Member States to achieve energy savings in the buildings sector. It would also facilitate the comparison of buildings throughout the EU for prospective users and make it easier for designers and constructors to apply standards in other Member States.*".

Directive 2002/91/EC covered these through four main elements:

- Establishment of a general framework of a common methodology for calculating the integrated energy performance of buildings;
- Member States obligation to set nationally or regionally determined minimum standards on energy performance and apply them to new buildings and to existing buildings of more than 1000 m² when they are renovated;

[72] COM(2001)0226 final of 15 May 2001, proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings

- Establishment of national certification schemes for new and existing buildings on the basis of the above standards and public display of energy performance certificates and recommended indoor temperatures and other relevant climatic factors in public buildings and buildings frequented by the public;
- Introduction of national inspection requirements, so that heating and air-conditioning systems above certain thresholds should be regularly checked for their efficiency.

3. The EPBD, Directive 2010/31/EU on the energy performance of buildings (recast)

The EPBD did not change the scope of Directive 2002/91/EC and retained its main objectives and principles. The revision aimed at clarifying and simplifying certain provisions, extending the scope of the Directive to all existing buildings, strengthening some of its provisions so that their impact was more effective, setting enabling conditions for a common level of ambition, and providing for the leading role of the public sector. In doing so, the transposition and implementation was expected to be facilitated and a significant portion of the remaining cost-efficient potential in the buildings sector reaped.

Accordingly, the revised Directive had the following specific objectives:

- Provide a simple and unambiguous legal framework that will provide clear guidance and ease the transposition and implementation;
- Ensure that the policy instruments used stimulate further energy savings;
- Ensure that the measures have a wider coverage of the EU buildings stock and relevant energy consumption but are at low additional cost;
- Ensure that buyers/tenants/owners receive good quality information at a reasonable cost on the energy performance of buildings and about the performance of their heating and air-conditioning systems;
- Establish a base for cost-effective energy performance requirements for buildings or for their comparison;
- Stimulate the public sector to show good example in buildings' energy efficiency.

The EPBD was designed to result in a major modernisation of national building codes through the introduction of the cost optimality concept, leading up to the adoption of nearly zero energy standards. The latter reflected the fact that renewable energy and efficiency measures work together to improve energy performance of buildings.

More specifically, the EPBD introduced the following new provisions that did not exist in Directive 2002/91/EC:

- Several new definitions, including the concept of major renovation, multiple references to renewable energy sources and the framework definition of nearly zero-energy buildings;
- Article 5 on the calculation of cost-optimal levels of minimum energy performance requirements;
- Article 8 on technical buildings systems;
- Article 9 on nearly zero-energy buildings (NZEB);
- Article 10 on financial incentives and market barriers;
- Article 16 on reports on inspection of heating and air-conditioning systems; and

- Article 18 on independent control systems and Article 27 on penalties, which in combination provide for the establishment of enforcement mechanisms.

In addition, the Directive reinforced significantly the following provisions:

- Article 6, by requiring that the assessment of technical, environmental and economic feasibility of high-efficiency alternative systems such as decentralised energy supply or district solutions is documented and available for verification purposes;
- Article 7, by removing the 1000 m2 threshold for minimum requirements in existing buildings when they undergo major renovation;
- Articles 11 to 13 on Energy Performance Certification (EPC) systems, in particular as regards having recommendations adapted to the specific building and public buildings to lead by example through the display of EPCs; and
- Article 14 on inspections on heating systems by enlarging the scope of obligations to regularly inspect boilers to the inspection of all accessible parts of the heating systems.

As a result of the new and reinforced provisions, the main elements of the EPBD can be outlined in four blocks.

3.1. Determination of the energy performance of buildings (EPBD Articles 2(4) and 3, Annex I)

Setting minimum energy performance standards (Article 4) and certifying the energy performance of buildings (Articles 11 and 12) require a method to determine the annual energy that is consumed in order to meet the different needs associated with its typical use. Minimum requirements need to reflect the heating energy needs and cooling energy needs (energy needed to avoid overheating) to maintain the envisaged temperature conditions of the building, and domestic hot water needs. The related provisions of the EPBD are designed to ensure that Member States apply a methodology for calculating the integrated energy performance of buildings and building units (Article 3).

The methodology must be in accordance with the common general framework of Annex I aiming at including, in addition to thermal characteristics, other factors that play an increasingly important role such as heating and air-conditioning installations, application of energy from renewable sources, passive heating and cooling elements, shading, indoor air-quality, adequate natural light and design of the building. The methodology for calculating energy performance should be based not only on the season in which heating is required, but should cover the annual energy performance of a building. That methodology should take into account existing European standards.

3.2. Minimum energy performance requirements (EPBD Articles 4, 5, 6, 7, 8 and 9)

Building energy codes are generally recognised as the key policy instrument used by governments to limit buildings' pressure on the energy sector and the environment while providing occupants with comfort and modern living conditions.

The related provisions of the EPBD are designed to ensure:

- The application of minimum requirements to the energy performance of new buildings and new building units (Articles 4 and 6);

- The application of minimum requirements to the energy performance of:
- existing buildings that are subject to major renovation (Article 7, first two subparagraphs);
- building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are retrofitted or replaced (Article 7, third and fourth subparagraphs); and
- technical building systems whenever they are installed, replaced or upgraded (Article 8).

Minimum requirements related to building and to building elements that form part of the building envelope must aim at achieving a cost-optimal level (Article 5), determined by using a common comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements as set out in Delegated Regulation No 244/2012 of 16 January 2012.

Member States must use this framework to compare the resulting cost-optimal levels with the national minimum energy performance requirements, which they have adopted. Should significant gap, i.e. exceeding 15%, exist between the calculated cost-optimal levels of minimum energy performance requirements and the minimum energy performance requirements in force, Member States should justify the difference or plan appropriate steps to reduce the gap.

Minimum requirements must be reviewed at regular intervals, which shall not be longer than five years and, if necessary, must be updated in order to reflect technical progress in the building sector.

The EPBD also gave a push to increasing the number of highly efficient buildings, obliging Member States to make sure that by the end of 2020 (2018 for public buildings) all new buildings are nearly zero-energy buildings (NZEB) and, for this purpose, requiring Member States to draw up plans for increasing the number of NZEB (Article 9).

3.3. Provision of information through certification and inspection (EPBD Articles 11, 12, 13, 14, 15, 16, 17, 18 and annex 2)

Certification and inspection are designed as a information-based instrument to inform in particular prospective owners and tenants, about the performance of specific buildings/system and about ways to improve the energy performance through specific recommendations.

The EPBD defined a common approach to the energy performance certification of buildings and to the inspection of heating and air-conditioning systems, carried out by qualified and/or accredited experts, whose independence is to be guaranteed on the basis of objective criteria. The intention was to ensure transparency for prospective owners or users with regard to energy performance in the Union property market. In order to ensure the quality of energy performance certificates and of the inspection of heating and air-conditioning systems throughout the Union, an independent control mechanism must be established in each Member State.

The related provisions of the EPBD are designed to ensure:

- energy certification of buildings or building units;

- regular inspection of heating and air-conditioning systems in buildings; and
- qualification of experts and independent control systems for energy performance certificates and inspection reports.

3.4 Financial and fiscal incentives and information campaigns (EPBD Articles 10 and 20)

The EPBD recognises the role that financial initiatives can play in giving practical effect to the objectives of this Directive, without however substituting national measures. As a concrete measure to provide the Commission with adequate information, the Directive (Article 10) requires Member States to draw up lists of existing and proposed measures, including those of a financial nature, other than those required by this Directive, which promote the objectives of this Directive.

The EPBD (Article 20) requires Member States to inform owners or tenants of buildings or building units of the different methods and practices to enhance energy performance, providing information to owners or tenants of buildings on energy performance certificates and inspection reports, their purpose and objectives, on cost-effective ways to improve the energy performance of the building and, where appropriate, on financial instruments available to improve the energy performance of the building.

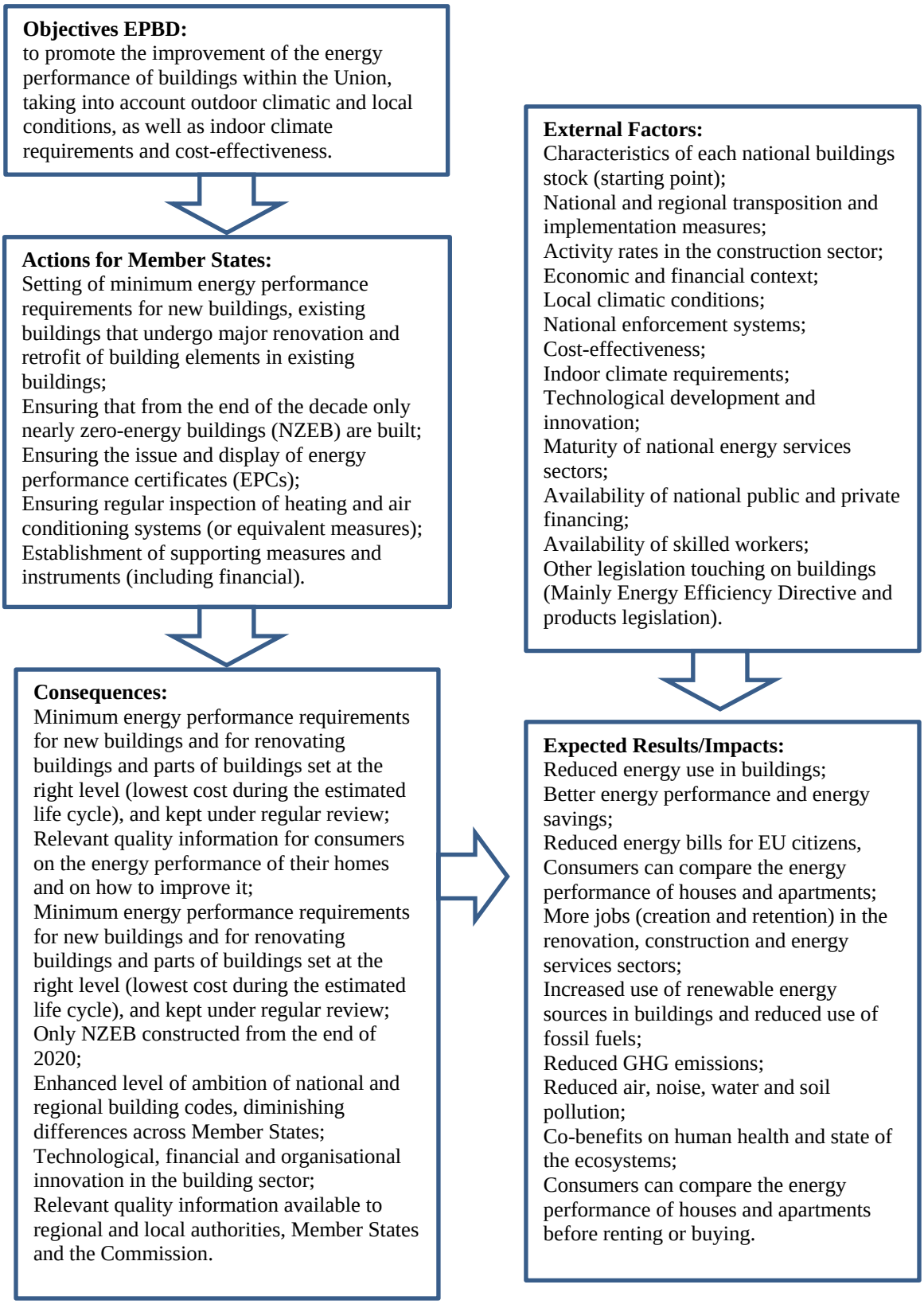
4. Type of obligation and target groups

The different provisions of the EPBD take effect at different times of a building's lifetime:

- After any construction activity: Minimum energy performance requirements are to be met when buildings are built, when they undergo major renovation (i.e. typically every 25 to 40 years) or when a building element is replaced or retrofitted.
- During a real estate transaction: The energy performance certificate is required only when buildings are newly constructed, sold or rented out and is valid for a maximum of 10 years:
- Periodically: Inspections of heating and cooling systems are independent of the sale or rent of a building. EPBD inspections should consist of an assessment of system efficiency with recommendations for improvement, documented by an inspection report, and therefore come on top of annual maintenance for boilers as the inspection. Their regularity is a function of the size, fuel source and average lifetime of the system.

The Directive's main instruments address different actors: certificates are to be issued by qualified expert, under the responsibility of home or building owners and advertised in commercial media. Minimum energy performance requirements are to be ensured by promoters, designers building constructors, and renovation companies such as ESCOs. Inspections are primarily the responsibility of the building owner.

5. Intervention logic of the EPBD



Annex 4 PROCEDURAL INFORMATION

1. Lead DG

DG ENER

2. Associated Commission Services

SG, Legal Service (SJ), Agriculture and Rural Development (AGRI), Budget (BUDG), Climate Action (CLIMA), Communications Networks, Content and Technology (CNECT), Competition (COMP), Economic and Financial Affairs (ECFIN), Employment, Social Affairs and Inclusion (EMPL), Environment (ENV), Eurostat (ESTAT), Financial Stability, Financial Services and Capital Markets Union (FISMA), Health and Food Safety (SANTE), Internal Market, Industry, Entrepreneurship and SMEs (GROW), Joint Research Centre (JRC), Justice and Consumers (JUST), Mobility and Transport (MOVE), Regional and Urban Policy (REGIO), Research and Innovation (RTD), Taxation and Customs Union (TAXUD), Trade (TRADE), Executive Agency for Small and Medium-sized Enterprises (EASME).

3. Agenda planning/WP references: 2015/ENER/023

The preparatory work to assess the application of the EPBD, financing of energy efficiency and knowledge about the building stock started in 2014 to ensure that the information would be ready for the Impact Assesment in 2016. Additional studies in support of the *ex-post* evaluation of the EPBD, *ex-ante* analysis of policy options including of 'Smart Financing for Smart Buildings' and modelling were launched in the first quarter of 2015.

The Secretariat General (SG) has set up an Inter-Service Group on the review of the EED, the EPBD and the 'Smart Financing for Smart Buildings'- initiative. The group met in total nine times in support of the full review process, from 30 April 2015 to 28 June 2016.

4. Consultation

4.1. On-line public consultation

The communication on the general principles and minimum standards for consultation of interested parties by the Commission requires that, without excluding other communication tools, open public consultations should be published on the Internet and announced at the “single access point”. In line with this purpose, an open internet-based consultation on the evaluation of the Energy Performance of Buildings Directive was carried out from 30 June to 31 October 2015 (longer period than the mandatory 12 weeks consultation). The target groups of this consultation were Public authorities, Member States authorities, private organisations, industry associations, SMEs, Consultancies, other relevant stakeholders and Citizens (inside and outside of the European Union).

The questions were elaborated in a way that the consultation feeds well into the evaluation and at the same time provides a basis for the identification of policy options that will be part of the Impact Assessment in the framework of the EPBD review. Position papers were received through a dedicated functional mailbox.

The open internet consultation closed on 31 October 2015. Summarised results of this consultation are available on line[73]. 308 stakeholders sent inputs within the timeframe. More than half (58 %) of respondents were organisations, mainly representing the construction sector industry, followed by companies (20 %) operating in Member States of the European Union. Individuals, Public Authorities and others represent 7-8 % of the respondents.

Results are available in the link below: https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

The contributions cover all EU Member States, the top 6 in coverage being Germany, Belgium, the United Kingdom, France, Spain and the Netherlands. Respondents generally understood the possibility offered to reply only to the section(s) of their interest. 94% of respondents answered to the "Section A: Overall assessment" while, at the other end of the scale, 46% of respondents covered "Section I: Sustainability, competitiveness and skills in the construction sector".

The results can be summarised as follows:

- In general, the additional administrative and regulatory processes created by the EPBD are considered necessary by most of the respondents to the public consultation, in the light of the energy saving potential in the buildings sector.
- The vast majority of the respondents to the open public consultation have clearly stated that the EPBD respects the principles of subsidiarity, mainly because the Directive allows for a lot of flexibility for Member States to take into account different climate conditions, building types, and accordingly define minimum requirements, NZEB levels, certification schemes, etc. However, some respondents point out that this flexibility has led to the impossibility of establishing direct comparisons of building performance, NZEB levels, and certificates across Member States. Consequently, within the replies to the question on subsidiarity (question 13 of the open public consultation), many stakeholders call for more harmonisation in the calculation of energy performance and the use of CEN standards, while taking advantage of the flexibility that these (and the Directive) allow.
- Several respondents highlighted poor compliance and enforcement of national measures while others recognised that the economic crisis in the construction sector has slowed improvements.
- Regarding new buildings, the pathway towards nearly zero-energy buildings by 2020 is perceived as an important signal. Stakeholders call for a similar vision for existing buildings.
- A vast majority of stakeholders believes that the EPBD is contributing to cost-effective improvements in energy performance of buildings (question 5 of the open public consultation). The setting up of minimum energy and maintenance requirements is now based on cost optimality, which is technology neutral, performance based and cost-effective. This mechanism is a major driver for continuing the efforts on improving energy performance of buildings in a realist way. Some stakeholders also suggested that cost-optimality should be taken to a next step and include other benefits, e.g. positive asset value, as increased work

[73] Public Consultation on the Evaluation of the EPBD – Final synthesis report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

productivity, less employees on sick leave, lower healthcare costs, healthier indoor environment, or levels of minimum requirements that go beyond cost-optimality at a certain point in time.

- Respondents to the public consultation mentioned that renovations are usually made 'step by step', and that those single steps should not trigger the major renovation threshold (this is also acknowledged in the EPBD recast 2008 Impact Assessment). However, the current Directive does not ensure that step-by-step renovations (which do not qualify as major renovations) are to be carried out following a cost-optimal pathway over the long run (e.g. in line with an energy audit or a building passport, linked to financial support).
- The views of stakeholders on the impact of energy performance certificates (question 10 of the open public consultation) vary. In some countries EPCs are perceived positively, and used as an information tool to inform buy/rent decision making. A common point mentioned by several stakeholders is the fact that the certificate presents estimated energy consumption (asset rating) which frequently is different from the actual energy use (operational rating). This is caused by the fact that for the estimated energy use a typical consumption profile is used, which is makes the result behaviour independent. However, the discrepancies are also caused by lack of quality of the national energy performance calculation methodologies in some cases.
- Stakeholders see a lack of demand for building renovation, which seems to be linked to the absence of long term regulatory goals, e.g. building owners are not yet convinced that all existing buildings will have to be renovated, at a certain moment, to a certain level. Another issue is the lack of trust towards the future financial benefits.
- Many respondents to the public consultation suggested better linkages between NZEB and EPCs, by making NZEB a specific certification class. Stakeholders also suggest reinforcing the link between EPCs and financial support schemes for building renovation.
- The consultation of Member states, organised in the context of the Concerted Action, indicated that the mandatory setting of overall technical building system requirements in existing buildings is complex, difficult to define and expensive to enforce.
- It is acknowledged by industry stakeholders, including the Energy Efficiency Financial Institutions Group (EEFIG) that further EU-level harmonisation and guidance concerning methods for data collection, data analysis and protocols for data sharing is important (e.g. an indispensable prerequisite for aggregation of small scale projects and development of attractive financial products).

4.2. Consultation with the Member States

12 contributions from national authorities were received through the on-line public consultation, within or after the timeline, and were analysed separately.

To complement the on-line public consultation on the review of the EPBD that took place from 30 June 2015 to 31 October 2015, the Commission hosted a dedicated consultation of Member States in the framework of the Concerted Action on 26 and 27 November 2015. Member States and experts were split into three parallel sessions, focusing on different parts of the Directive. All Member States sent several representatives from different ministries and national energy agencies.

Regarding minimum energy requirements for new and existing buildings, majority of the participants agreed that renovation works are usually made ‘step by step’, and that those single steps do not necessarily trigger the major renovation threshold. Several Member States supported voluntary individual building roadmaps linked with government funding to complement the "major renovation" approach.

Most of the Member States' experts agreed that Energy Performance Certificates (EPC) are important tools both for linking the energy efficiency investments with housing prices and for checking compliance. However, experts agreed on the need for improving EPC reliability. Experts agreed that developments in the product technologies can also further facilitate compliance. Importance of tax incentives in increase compliance was also mentioned.

Regarding nearly zero-energy buildings (NZEB), a majority of experts agreed on the need to avoid EU mandatory interim requirements for use of renewables in buildings, which hamper cost effectiveness and limit national flexibility to set the right set of provisions. Experts agreed that provisions to support off-site or nearby use of renewables do not belong in the Buildings Directive but rather to the overall market design and grids modernisation.

Experts agreed on that District Heating Cooling (DHC) cannot be promoted everywhere and they not see any added value for the EPBD to emphasise DHC. Instead, the heat roadmap of the EED is mentioned as a useful exercise to actually sort out this question of opportunity.

Regarding technical building systems, experts consider the mandatory overall system energy performance requirements in existing buildings as a challenge to implement due to the lack of technical standards. A further challenge is the level of investment to assess the system in place, and to enforce the requirements while the authorities are generally not informed when technical building systems are replaced or put in place. Most of the participants reminded that some parts of these systems are regulated by the Ecodesign and energy labelling directives and that the overall efficiency of technical systems is reflected and covered by overall building performance and minimum requirements.

Moreover, mandatory regular inspections are considered by experts as an archaic way, while continuous electronic monitoring is a more efficient way. However, most of the experts agreed that a one-off inspection after installation/upgrade of a key component of the systems would be necessary for ensuring proper installation.

Lastly, regarding information and finance, Member States reported a lack of awareness and willingness to invest. Experts emphasized the need for a one-stop-shop and a step-by-step guide for renovation. Moreover, split incentives challenge seems to remain in the market, while on the other hand lack of trust in the EPC providers and lack of effective links with financing is being reported.

The Committee set up under Article 26 of the EPBD met on 1 February 2016 as part of the consultation process. The Commission services presented the consultation activities and briefly summarised their outcome. The opportunity to receive additional input from Member States was left, in particular on the cost and cost/benefits associated with the national/regional implementation of the EPBD. No additional information was received upon this opening.

4.3. Specific Workshops

Further stakeholders opinions have been collected throughout the full review process. Thematic expert workshops were organized targeting, depending on the theme, relevant stakeholders in public authorities, industry and other groups. These workshops can be listed as:

- 11 November 2015: Workshop on "Territorial Impact Assessment",
- 7 December 2015: Workshop on "Smart buildings, building automation, intelligent metering and demand response",
- 8 December 2015: Workshop on "On-buildings renewable energy",
- 9 December 2015: "Workshop on "Practical Approaches to the Building Renovation Challenge",
- 15 December 2015: Workshop on "Healthy and Energy-Efficient Buildings in the EU",
- 20 January 2015: Workshop on "Unlocking the energy efficiency potential in the rental & multifamily sectors",
- 21 January 2015: Workshop on "Provision of consumption information to final customers".

4.3.1. Workshop on "Territorial Impact Assessment"

The Better Regulation guidelines, approved in May 2015, describe that all potential impacts should be mapped out according to their expected magnitude and likelihood and to the specific parties that would be affected, including different territories and regions.

In June 2015 the Directorate-General for Regional and Urban Policy started a test phase to see which methodologies can best be used to quantify these territorial impacts. As part of the revision process of the EPBD DG REGIO conducted a pilot test on the Territorial Impact Assessment (TIA) of the Directive testing two methodologies:

- Sub-national LUISA modelling and data collection performed by the JRC, with early results for two case-studies, one in Italy and one in the Netherlands.
- Workshop with 10 European cities using the ESPON TIA Quickscan methodology.

The results of this first test phase were presented in a report drafted by DG REGIO and JRC in close cooperation with the European Committee of the Regions and the European Territorial Observation Network. EUROCITIES and CEMR supported the work and provided the contacts to most of the city experts. The report presents also a short reflection on the added value and limitations of the used methodologies (JRC-LUISA, ESPON Quickscan) and main reflections collected during the workshop with urban experts.

Experts agreed on the potential of the EPBD to contribute to the increase in GDP and to increase entrepreneurship in metro regions. Moreover, experts emphasized the need for further exploration for local economic opportunities in order to increase employment in the construction sector and household disposable income. Regarding the employment in the energy sector, according to experts, while some jobs might indeed be lost in the industry linked to fossil fuels, other highly qualified jobs might be created (as energy experts needed).

Experts from city administrations agreed on the need for further compliance among the Member States. Some experts reported negative impacts of taxing on the energy efficiency investments; which should also be taken into account. Experts argued that as the energy costs of a building are marginal in many cities, compared to house or rental prices, which appears to be a disincentive for EPCs. The significance of addressing the ownership issues (split incentives challenge) in building sector is emphasized, particularly when carrying out renovations.

In conclusion some policy recommendations were discussed in the final part of the meeting. These are; (1) the need for a life-cycle approach for building renovations, (2) provision of more flexibility in conservation and social housing areas, (3) inclusion of behavioural aspects in the directive and (4) improvement of Energy Performance Certificates in terms of their scope and content.

4.3.2. Workshop on "Smart buildings, building automation, intelligent metering and demand response"

Workshop on Smart Buildings, Building Automation, Intelligent Metering and Demand Response was held on 7 December 2015 with the participation of relevant market participants and representatives of research institutes.

The participants of the workshop stressed the lack of a shared understanding of what 'smart building' means and the need for differentiation of sectors due to the different dynamics. Referring to the recent technological developments, most of the participants argued that technical barriers for energy efficiency investments are almost over, while improvements are needed to remove regulatory and financial barriers. The need for regulatory incentives for smartness in buildings (towards the occupant and better comfort, and towards the grid integration) is stressed. Moreover, some participants recommended the introduction of a label for smart readiness (i.e. smartness indicator). It is acknowledged that this may require an implementing power in the EPBD for the Commission to develop such a label, possibly following an approach similar to the one used for smart appliances, including the preparatory study and stakeholder process. Other possible incentives were also discussed, such as establishing links between building automation and energy performance contracting.

4.3.3. Workshop on "On-buildings renewable energy"

Workshop on Renewable Energy was organised on 8 December 2015. Main conclusions of the workshop are as listed below:

- On-building renewables moving in the right direction, but at a slow pace. Recognition that energy efficiency and renewable energy sources work better together
- Main barriers relate to market design issues, e.g. national provisions preventing self-consumption
- Question mark on the adaptability of the cost-optimal tool, and in particular its financial perspective aspects, to changes in framework conditions over time or whether there is inertia to stick to the initial set up i.e. mature and cost-effective technologies at the time of performing the calculations for the first time
- Need to clarify the NZEB provisions
- Lack of an harmonised calculation methodology perceived as a problem

4.3.4. Workshop on Practical Approaches to the Building Renovation Challenge:

The workshop was organized by EASME and it involved experts from about 40 EU-funded projects (H2020, FP7, IEE, and regional and cross-border programmes) representing a cross-section of the buildings sector (researchers, engineers, architects and other practitioners). It focused on 4 different aspects of EE policy particularly in buildings.

Regarding the construction sector, a room for improvement is reported, particularly in offering holistic solutions for deep renovation at acceptable cost and quality. The building process usually involves multiple separated disciplines, which leads to additional costs and risk of failure. The renovation market is principally supply driven which can lead to a mismatch between the offered products and the end-user's needs. Many customers see high operating costs and poor environment as an acceptable alternative to the time-consuming, disruptive and risky renovation process. Participants indicated the need for practical trainings and other soft measures related to energy efficient construction, e.g. air tightness.

Moreover, the participants emphasized the need for district-scale planning when integrating renewable energy sources, whereas design and certification of Nearly Zero Energy Buildings is usually done at the level of an individual building. Moving the emphasis from building to districts escalates from a single-stakeholder decision to a multi-stakeholder decision. Participants recommended the introduction of low-regulatory zones where some of the regulatory barriers to renewables installations are relaxed.

In addition, a "district level EPC" concept is also recommended, which is already being investigated in Austria and Switzerland. Participants indicated a lack of trust in the EPCs, which shows that there is a need for improved monitoring to assess the correctness of EPC predictions.

The participants also indicated that challenges and barriers are aggravated when scaling up from building to district. In general, there is a lack of interaction between stakeholders (silos in authorities, dispersion of decision making) at all levels. In certain contexts, the age structure is a strong barrier ("old owners, old houses"), as well as the "hassle factor" or intrusiveness of building renovation measures.

The final paper from the workshop is available for download on www.buildup.eu

4.3.5. Workshop on "Healthy and Energy-Efficient Buildings in the EU":

The Workshop on “Healthy and Energy Efficient Buildings in the EU” was organized by JRC and DG ENER on 15 December 2015 in Brussels with the aim to directly inform the review process of the EU energy efficiency legislation in 2016. The outcome of the workshop served as an input for the preparation of the JRC report: "Promoting healthy and energy efficient buildings in the European Union"[74].

Three main issues were addressed in the consultation process regarding the indoor air quality (IAQ), comfort and health conditions related to buildings in EU MS. These are:

[74] "Promoting healthy and energy efficient buildings in the European Union: National implementation of related requirements of the Energy Performance Buildings Directive (2010/31/EU)", European Commission’s JRC, 2016 (EUR 27665 EN)

(1) reviewing the implementation status in the EU MS of the EPBD recast provisions relating to ventilation, indoor air quality and energy efficiency criteria and requirements; (2) assessing the impact of tightening energy efficiency requirements on IAQ, comfort and health conditions of the buildings' occupants in EU; (3) formulating policy and technical related recommendations to enable the effective implementation of healthy and energy efficient buildings in the EU.

The EPBD laid down new concepts such as nearly zero energy buildings (NZEB) and minimum requirements in new and existing buildings in EU. The progression towards meeting the targets for NZEB by 2020 resulted in a stepwise tightening of minimum energy performance requirements in EU MS. This poses a risk of deterioration of IAQ, comfort and health conditions in the European building stock. In order to avoid or mitigate such risks, stakeholders indicate that increased emphasis should be put on the integration of energy sufficiency, energy efficiency and renewable energy supply measures with appropriate strategies dealing with indoor and outdoor pollution sources, ventilation, thermal comfort, acoustics and lighting. Moreover, adoption of a perspective which also takes IAQ, comfort and health conditions properly into account is strongly argued by the participants.

Secondly, it is indicated that although there are national standards regulations regarding ventilation, they are missing a health-based approach and perspective among the EU MS. Considerable discrepancies exist in EU MS between measured ventilation rates and ventilation rates required by national regulations and European standards. The same applies also for other parameters of the indoor environment quality (IEQ) such as thermal comfort, lighting (including daylighting) and noise. Stakeholders report the need for EU-wide common health-based ventilation guidance that will reinforce the definition and setting of ventilation requirements and metrics based on health criteria after all possible control strategies of indoor and outdoor pollution sources are exploited. Moreover, inclusion of IAQ and health-based related requirements and measures in energy efficiency inspections of buildings is recommended in the review process of EPBD in line with other building and product related product legislations.

Thirdly, experts argue that compliance and monitoring procedures are mainly focusing on structural, and energy performance aspects during the buildings' design stage having and give much less emphasis on the operational and occupation phases of buildings. To address this problem, stakeholders recommend a common, flexible and comparative methodology in EU including guidelines for compliance checks, ensuring the assessment of energy efficiency, IAQ and comfort related measures to avoid health risks of the buildings' occupants while optimising energy expenditures. Moreover, extension of EPCs to include ventilation systems and IEQ performance of buildings is also recommended.

Last but not least, it is recommended to expand the existing EPBD Comparative Methodology Framework by establishing key performance indicators for energy use, health, comfort and IEQ in buildings. These should be integrated with a proper cost indicator for estimating the co-benefits of measures for energy-efficiency health and comfort in indoor environments, in the context of calculations for cost-optimisation at macroeconomic level, particularly in the case of renovation measures related to the existing EU building stock (i.e. gains from energy savings, less health care costs, less absenteeism rates from work, increased productivity). Furthermore, clear provisions and criteria should be introduced in the calculation methodology of the energy performance of buildings (including cost-effectiveness and cost-optimality calculations)

so that simulated scenarios and subsequent energy efficiency measures (while optimising on energy savings and costs) shall also guarantee good indoor air quality and comfort conditions for the buildings' occupants at the design and operation phases of new and renovated buildings during their entire lifespan.

4.3.7. Workshop on "Unlocking the energy efficiency potential in the rental & multifamily sectors"

Asymmetric information and split incentives are typically regarded as major barriers to fostering energy efficiency upgrades in rented and multi-unit properties both in the private and public as well as residential and commercial sectors. The EED (Article 19) calls for Member States to take measures addressing these barriers. Current solutions vary in nature, ranging from revised rent acts, green leases, on-bill finance mechanisms, minimum energy performance standards, use of inclusive rents and others.

A workshop was organised by Commission Services on 20 January 2016, with the aim of receiving stakeholders' reflections on these possible solutions. Within the current EU regulatory framework, there are no obligations for landlords to renovate their buildings. A key aspect to encourage energy efficiency renovations is having a stable rental framework. The legal background is reported to be fairly complex at EU level. Experience shows that although energy efficiency renovations are recognised as drivers to increase the property value, landlords are reluctant to invest unless there is a subsidy scheme in place. An additional element that creates some uncertainties is that baselines to compare the percentage of renovation are considered quite unclear among Member States.

4.3.8. Workshop on "Provision of consumption information to final customers"

This workshop was organised by Commission Services in order to support to the Implementation of EED Article 10 in relation to billing information on 21 January 2016.

As historical data on actual energy consumption is considered a powerful tool in encouraging the customers to better manage their energy consumption through self-checks, the issue is addressed by the Article 10 of the Energy Efficiency Directive (EED). The article makes a number of requirements on billing information and the cost of access to metering and billing information.

This stakeholder workshop aimed at exchanging information on effective ways to tackle issues related to the provision of information on historical consumption, to collect/share information on good practices and principles for the provision of historical information to final customers and to provide main principles as well as practical hints on how historical information should be provided to final customers in an effective and cost-efficient way.

4.4. Conclusion on the consultation process

In conclusion, the benefits of being open to outside input from external stakeholders are already recognised during the review process of EPBD. An internet-based public consultation (which is far longer than the mandatory 12-week consultation) was carried out, reaching Public authorities, Member States authorities, private organisations, industry associations, SMEs, Consultancies, other relevant stakeholders and Citizens (inside and outside of the European Union). Additional comments and position papers

of the respondents were received via a dedicated functional mailbox. A separate platform of consultation for the Member States is established under the Concerted Action EPBD. Moreover, workshops were organized on specific sub-topics, targeting different stakeholder groups in various subsectors relevant to the implementation of EPBD. The consultation processes of other Commission services are also utilized with the purpose of an effective consultation process.

5. External Expertise

5.1. Studies

Different studies supported the monitoring of the implementation of the Directive and provide relevant input to this Evaluation, as follows:

- Progress towards Nearly Zero-Energy Buildings[75]
- Impact of Energy Performance Certificates on property valuation[76]
- Assessment of the national/regional methodologies for the calculation of the energy performance of buildings[77]
- National implementation of the cost-optimal methodology[78],
- Compliance with the national regulatory frameworks[79].

A specific study for the evaluation of the application of the EPBD and assessment of policy options and resulting energy related impacts in the framework of the EPBD review kicked off on 25 June 2015. The study delivered the summary report following the public consultation[80].

5.2. Other sources

Outcomes of projects funded under the 'Energy efficiency' chapter of 'Secure, clean and efficient energy' under H2020 and its predecessor the Intelligent Energy for Europe (IEE) programme were analysed and referenced where relevant.

In addition to the consultation activities involving the European Commission, this evaluation made use of other sources of information, e.g. research papers, identified through literature review. When such sources of information are used in the current evaluation, they are explicitly referenced.

6. Overall opinion of the scrutiny board on the draft dated on 2 March 2016

A draft evaluation dated on 2 March 2016 was submitted to the scrutiny board.

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75 Overview of MS information on NZEBs - Background paper and progress report, 2014, European Commission (written by ECOFYS)

76 Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries, 2013, European Commission (written by Bio Intelligence Service)

77 Technical assessment of national/regional calculation methodologies for the energy performance of buildings, 2015, European Commission (written by CSTB/TSUS)

78 Assessment of cost-optimal calculations in the context of the EPBD, 2015, European Commission (written by Ecofys)

79 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

80 Public Consultation on the Evaluation of the EPBD – Final synthesis report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

The regulatory scrutiny board met on the 6 April 2016 and, in its opinion, found scope for further improving the evaluation report with respect to the following key aspects:

(1) The assessment of coherence should be improved and conclusions supported with evidence. In doing so, the report should better explain the scope, the policy context and the coherence with other energy efficiency initiatives and evaluations. It is sensible that a fitness check of the directive (together with other related instruments) be undertaken in the next round of the policy cycle to explore better the coherence between different but related policy instruments;

(2) The report should clarify the effectiveness of the Directive in reaching its policy objectives, in particular those specified in the 2008 Impact Assessment. To what extent can the available evidence be used to attribute energy savings in the buildings sector to this directive as opposed to other instruments such as financing instruments, the energy efficiency directive and the effort sharing decision etc.;

(3) The evidence supporting the efficiency assessment of the Directive should be better demonstrated, in particular regarding the cost-effectiveness. In this context, the report should explain upfront any limitations and justify them;

(4) In view of the envisaged impact assessment, the reasons behind the slow progress in the area of building renovations should be better elaborated as well as those aspects of implementation which have been found to be problematic;

(5) The lack of available data should be explained, including clarifications on how the problem will be dealt with in the future. The report should be shortened and streamlined, in order to fulfil the Better Regulation guidelines requirements.

The Evaluation was completely redrafted in response to need for shortening (Point 5). In addition, comments were addressed in further elaborating the respective following sections of the present document:

(1) Section 6.4 and Annex 12;

(2) Section 6.1 and Annex 9;

(3) Section 6.2 and Annex 10;

(4) Sections 5.3 and 6.2;

(5) Section 5.2.

Annex 5 STATE OF IMPLEMENTATION

The Commission services have monitored the EPBD in terms of its transposition, conformity and correct application through direct contact with the national authorities, visits to Member States, meetings, dialogues through the EU Pilot tool[81], and ultimately infringement procedures.

As the transposition depends on Member States' constitutional rules and internal allocation of competences, the level of existing legislation, and the strategy for the transposition, differences in results occur. Communication and dialogue in the context of infringement procedures help Member States to align their legislation with what the EPBD requires.

1. Full transposition

Infringement procedures for not having fully transposed the EPBD (so-called non-communication cases or cases of failure of Member States to communicate all the necessary transposition measures) were launched against all Member States, as the assessment of the Commission revealed the existence of transposition gaps. The transposition verification consists in evaluating whether each obligation of the Directive is reflected in the national law.

Among these 28 Infringement procedures:

- 5 closed at the stage of letters of formal notice,
- 15 closed at the stage at the stage of reasoned opinion,
- 8 closed at the stage of additional reasoned opinion.

The non-transposition exercise ensured that transposition was complete in all 28 Member States. This however did not necessarily imply that all provisions of the directive were correctly transposed and enforced. This further assessment was performed through more in-depth investigations with the concerned Member States.

2. Correct transposition

The Commission investigated the conformity of national law with the Directive in the framework of EU Pilot information requests. The EU Pilot tool allows the Commission services to engage a constructive dialogue with Member States authorities in order to assess whether all of the EU legal requirements are complied with. On that basis, the Commission services progressively launched EU Pilots information requests investigating compliance with different requirements of the EPBD.

Within this process:

- 4 non-conformity EU Pilots request were closed at this dialogue level,
- 8 of the dialogues are still on-going,

[81] "EU Pilot" is a scheme designed to resolve compliance problems without having to resort to infringement proceedings. It is based on a website which the Commission and national governments use to share information on the detail of particular cases, and give governments a chance to remedy any breaches through voluntary compliance.

- 16 EU Pilot requests were closed, 14 with the subsequent opening of infringement procedures, 9 of which are at the stage of a letters of formal notice and 3 is at the stage of a reasoned opinion. 2 letters of formal notice were closed.

3. Correct application

From 2011 to date, 42 complaints for violation of the EPBD requirements were registered leading to 4 dialogues with Member States within the Eu-Pilot system. The majority of complaints concerned the energy performance certificates system as well as certain energy efficiency measures introduced by Member States.

4. Specific proceedings for reporting obligations

In addition to the general proceedings:

- 23 EU Pilots were launched for failure to submit the Cost-optimal report satisfying the obligations of Delegated regulation 244/2012, and 19 information requests were sent for submitting incomplete cost-optimal reports,
- 11 EU Pilots were launched for failing to communicate the consolidated information on increasing the number of nearly zero-energy buildings.

In addition, the Commission services had specific discussions with the Member States that opted, as an alternative to regular inspection schemes, for measures to ensure the provision of advice to users on the replacement of boilers or air-conditioning systems or on other modifications to the heating and air-conditioning systems. The 13 Member States that choose to alternative measures to the regular inspection of heating systems and the 7 Member States that choose to do so for air-conditioning systems had to submit to the Commission a report on the equivalence of those measures to the regular inspections.

5. Conclusions

From these proceedings it can be seen that the most difficult part to implement were related to:

- Article 5 related to the calculation of the cost-optimal levels of the minimum energy performance requirements, in particular for existing buildings: A large number of reports were delayed and/or incomplete. But proceedings considerably improved the situation. A progress report was recently issued[82];
- Article 7 related to minimum requirements for existing buildings and building elements: The obligation to ensure cost-optimal level requirements for buildings that undergo a major renovation and for building elements with significant impact on the energy consumption was unclear for some Member States. The matter was discussed with Member States within the Committee;
- Article 8 related to system requirements for technical building systems: The setting of overall system requirements for technical building systems is seen as a challenge to implement due to the lack of technical standards. A further challenge is the need of investment to assess the system in place, and to enforce the requirements while the authorities are generally not informed when technical building systems are

[82] Report from the Commission to the European Parliament and the Council – Progress by Member States in reaching cost-optimal levels of minimum energy performance requirements; COM(2016)464 final of 29 July 2016.

replaced or put in place. The matter was discussed with Member States within the Committee;

- Article 9 related to nearly-zero energy buildings: The first Commission progress report on nearly zero-energy buildings[83] revealed a certain lack of preparation of some Member States and the need for further guidance. The Commission recently issued a Recommendation[84].

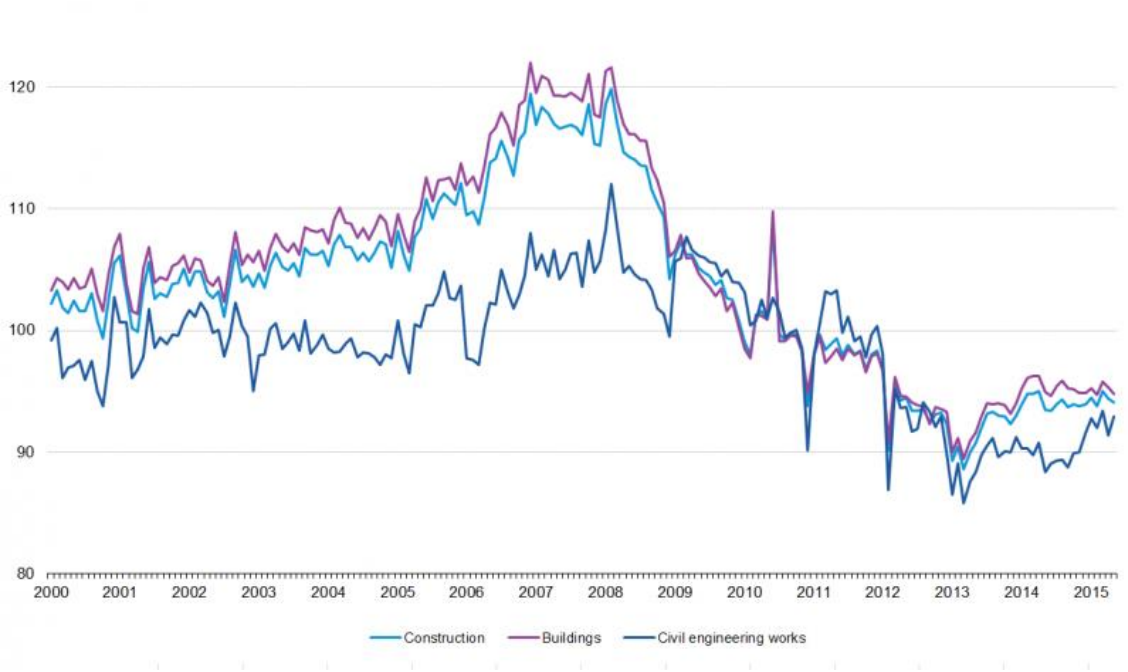
[83] Communication on Progress by Member States towards Nearly Zero-Energy Buildings, COM(2013)483/2 final of 17 October 2013.

[84] Commission Recommendation 2016/1318 of 29 July 2016 on guidelines for the promotion of nearly zero-energy buildings and best practises to ensure that, by 2020, all new buildings are nearly zero-energy buildings; O.J. L208, 2.8.2016, P46-57.

Annex 6 ECONOMIC CONTEXT

The downturn in construction activity within the EU-28 lasted longer than for industry. In May 2015 (latest recorded data) the level of the construction activity index for the EU-28 was still 35 %-points below the pre-crisis high (Figure 2). The construction of buildings accounts for around 78 % of total construction in the EU-28 and, unsurprisingly, the output for building works shows a similar development to the overall indicator for construction. The crisis in the building sector hit all EU-28 countries albeit to different extents. All countries experienced a decline in building production ranging from an extreme reduction of 54.5 % in Lithuania in 2009 to almost stable activity levels in Germany and Austria. In several countries (e.g. Estonia, Ireland, Latvia) growth rates had already begun to move considerably downwards before 2009 while in several other countries the drop in building activities happened in a more sudden way and was shorter.

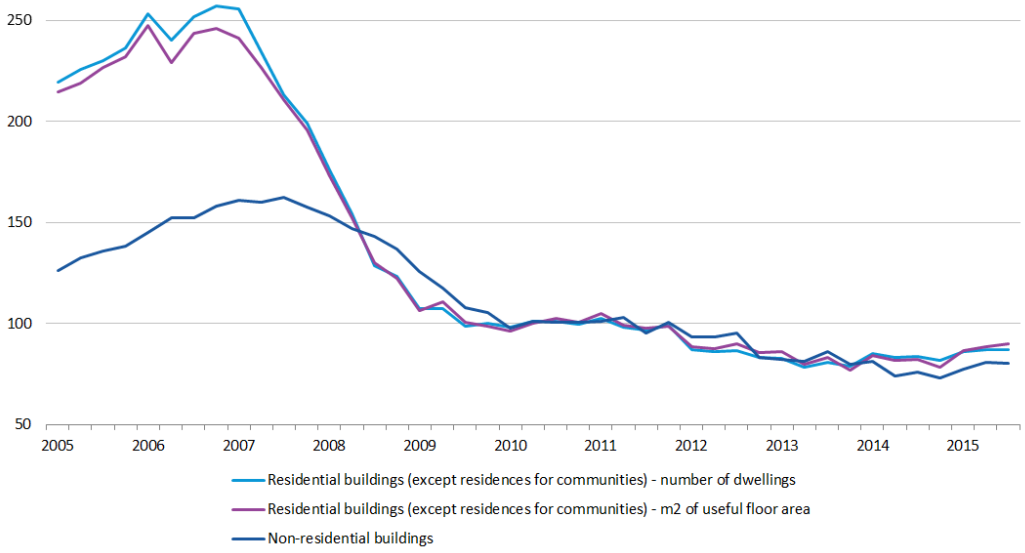
Figure 2: EU-28 Total construction, buildings and civil engineering activity index, 2000-2015, monthly data, seasonally and working day adjusted (2010=100), (Source: Eurostat, data table "sts_copr_a")



The building permits index of useful floor area[85], although most relevant for construction of new buildings (about 30-40% of the total production value of contractors), gives an indication of the future development of construction activity in terms of volume. During the 2010-2015 period, the index level remained quite stable but still far below the pre-crisis levels (Figure 3).

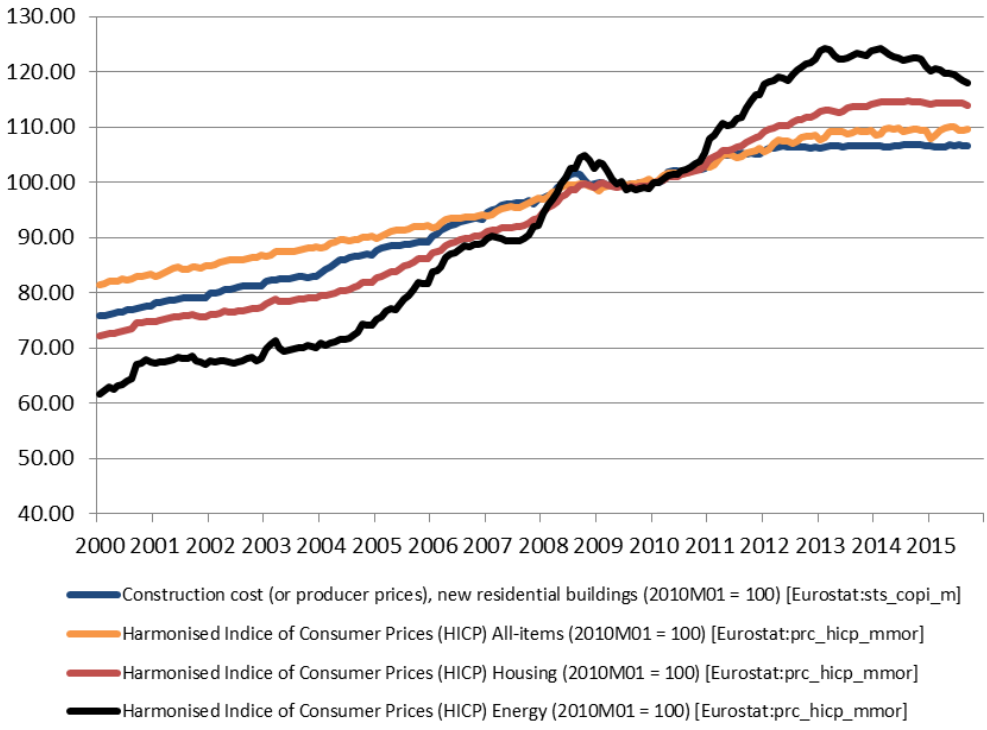
[85] The building permits index of useful floor area is compiled from the square metre of useful floor area of buildings for which permits have been granted (Source: Commission Regulation (EC) No 1503/2006 of 28 September 2006).

Figure 3: EU-28, Building permits index (number and floor area) 2000-2015, quarterly data, seasonally and calendar adjusted, (2010=100), (Source: Eurostat, data table "sts_cobp_q")



It should be noted that, the same 2010-2015 period, the reduced activity had limited impact on construction costs that generally kept increasing steadily, although at a relative slower pace than general prices, housing prices, and even energy prices. Therefore, despite the recent decrease of trend for energy prices and compared to 2010, overall the situation remains favourable to energy renovation, with still a higher relative increase of energy costs compared to construction costs and housing prices (Figure 4).

Figure 4: EU-28, 2000-2015 construction cost and consumer prices development (Source: Eurostat, data tables "sts_copi_m" and "prc_hicp_mmor")



As a result, low demolition rates (0.1– 0.2% per year), limited new construction activities (0.4-1.1% per year[86]) and very low refurbishment rates (0.4-1.2% per year[87]) were observed since the proposal for the EPBD in November 2008.

With construction rate significantly higher than the demolition rates, the building stock that is naturally expanding in size. With more space to heat, cool, ventilate, etc. the increasing size is bound to increase its energy consumption and hence also its carbon dioxide emissions.

With these construction and demolition rates[88], around 70% of the buildings that we will occupy in 2050 are already built. This confirms, if needed, that buildings are assets with a long lifetime, much longer than appliances, or cars, meaning that buildings have a natural trend to low replacement and refurbishment rates.

The supporting study for the on-going Fitness Check on the construction sector[89] estimates that new business opportunities generated by EU energy efficiency legislation at some €124 billion over the 2010-2014 period, corresponding to about 5% of the total value of the residential building market. This definitely constitutes a meaningful contribution to sustain the level of activity during a difficult period for the construction industry and also had positive effects across the whole supply chain, with an increase in the demand for energy efficient construction products and for energy efficiency-related professional services. In addition, considering the small scale of the majority of building renovation interventions (whose average values typically range between €4,000 and €10,000), EU legislation on energy efficiency in buildings contributed to enhance opportunities for small and medium companies.

86 GLOBUS model prognosis based on prediction of the gross domestic product and on the population.

87 An EU Strategy on Heating and Cooling, COM(2016) 51 final

88 Taking constant 0.1% demolition rate and 1% average construction rate results in having 96% of 2016 existing buildings still standing in 2050 and a net stock increase of 40%.

89 Supporting study for the Fitness Check on the construction sector: EU internal market and energy efficiency legislation, 2016, European Commission (Written by Economisti Associati, Milieu, CEPS, BPIE, DBRI)

Annex 7 COST-EFFECTIVE SAVING POTENTIALS FOR 2020

In 2014, Fraunhofer ISI conducted a study[90] to report on the evaluation of the achievement of the 2020 energy efficiency target of 20% and to discuss energy efficiency potentials in two different time horizons (2020, 2030).

Regarding the residential and tertiary sector, the modelling analysis done for this study was carried out with the following models:

- The INVERT/EE-Lab model (run by TU Wien);
- The FORECAST platform (run by Fraunhofer ISI);

These bottom-up models enabled a very detailed level of decomposition, which, contrary to other sources of information, gave an insight of the trends within the scope of the EPBD (space heating, space cooling, ventilation, domestic hot water, and lighting in non-residential buildings) and outside the scope of the EPBD (other uses, e.g. appliances, elevators, cooking, etc.).

The following scenarios are relevant for the purpose of identifying the cost-effective saving potentials:

- The baseline with measures, which contains measures which are already accepted or close to being accepted in 2014 and the near future. This scenario includes the EPBD;
- The potential with low policy intensity (LPI), meaning with high discount rates and barriers persisting. The discount rates applied for the study are sector and partially country specific;
- The potential with high policy intensity (HPI), with low discount rates and barriers (partially or totally) removed;
- The near economic (NE) potential that includes potential which are not economic (the Net Present Value is negative given the discount rates used in the HPI scenario) but the scenario induces costs not much higher than present level energy consumption entails. This differentiates the near economic potential from a pure "technical" potential which may include also higher cost.
- The results for 2020 are summarised in Table 1.

[90] Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy efficiency/saving potential until 2020 and beyond, 2014, Fraunhofer ISI.

Table 1: Projected 2020 energy consumptions and saving potentials (Mtoe) within and outside of the scope of the EPBD in different scenarios.

	Baseline with measures	Potential LPI	Potential HPI	NE potential
Residential	299.7	292.2	261.3	259.1
Within EPBD	234.3	228.1	199.5	199.5
Out of EPBD	65.4	64.0	61.8	59.7
Tertiary	151.4	125.1	114.3	114.3
Within EPBD	113.8	90.0	80.1	80.1
Out of EPBD	37.6	35.0	34.2	34.2
Residential & tertiary	451.1	417.2	375.6	373.4
Within EPBD	348.1	318.2	279.6	279.6
Out of EPBD	103.0	99.1	96.0	93.9
Total potential		33.9	75.5	77.7
Within EPBD		29.9	68.5	68.5
Out of EPBD		4.0	7.0	9.1

The following conclusions can be drawn upon these results:

- 77% of the 2020 energy consumptions would occur within the scope of the EPBD (348.1 out of 451.1 Mtoe in the baseline scenario);
- 33.9-77.7 Mtoe cost-effective potential[91] would remain in total for 2020, 88% within the EPBD scope.

The same study projects remaining cost-effective potential of 29.1-86.5 Mtoe within the EPBD scope for 2030. Only 1.2-5.2 Mtoe of cost-effective potential in new constructions are expected by 2030, which means that the saving potentials mostly lay in the existing building stock.

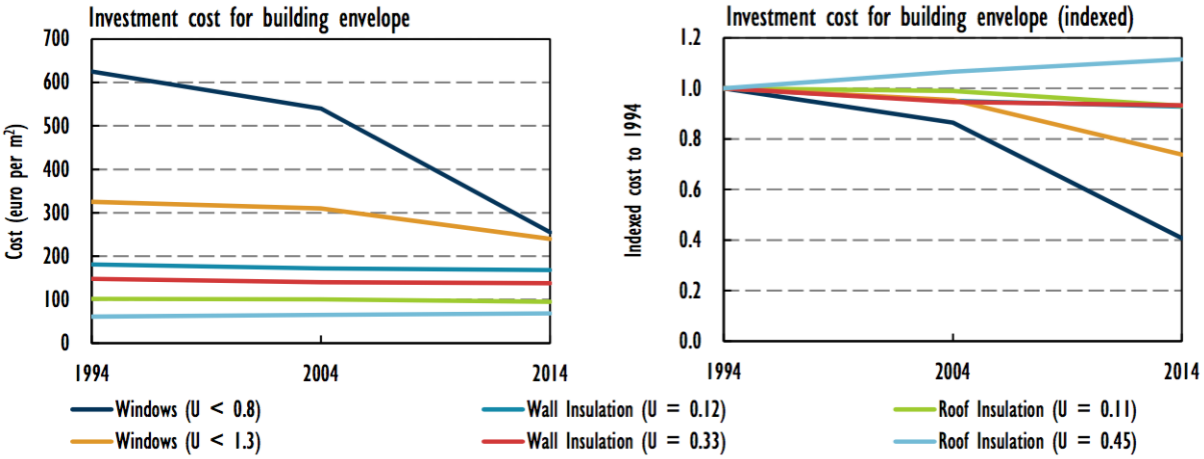
[91] The 2020 projections for the above baseline scenario is 30 Mtoe lower than with the latest updated EU Reference Scenario 2016 projections for 2020. This means that, taking the later as reference would lead to an additional 2020 saving potential of 50 – 95 Mtoe.

Annex 8 TECHNOLOGICAL PROGRESS

Technological progress and availability of cost-effective energy efficient solutions are key enablers to stimulate the demand for energy efficient buildings. Since the adoption of the EPBD in 2010, new technology developments and cost reduction of efficient technologies were observed.

For example, in Germany, a general trend of building envelope technology costs declining from 1994 to 2014 is evident, with the cost of windows falling most dramatically. Roof insulation, commonly the lowest-cost building envelope measure, has not shown any significant cost changes; as a result, when indexed it shows the only increasing cost trend (Figure 5).

Figure 5: Cost of building envelope measures in Germany, 1994-2014 (Source: IEA[92])



The European Union, with Canada, and the United States have made most progress in deploying energy efficient building envelopes[93]. Highly efficient building envelope components are available on the EU market, and most are considered to be mature (more than 50% of sales) or established (between 5 and 50% of sales) markets. For instance, the majority of windows sold in the European Union are double-glazed[94] and Austria, Germany and Switzerland have the highest market share for triple glazing usually with two low-e surfaces, at 54 % of total window sales.

Even the market for advanced insulation (e.g. aerogel, vacuum insulation products) and building integrated photovoltaic (BIPV)[95], although at initial stage (less than 5 % of sales), is more advanced than in other parts of the world. Also technologies that industrialise the retrofitting of buildings (e.g. through off-site pre-fabrication of larger

92 Energy Efficiency Market report, 2015, IEA

93 Technology roadmap – Energy efficient building envelopes, 2013, IEA

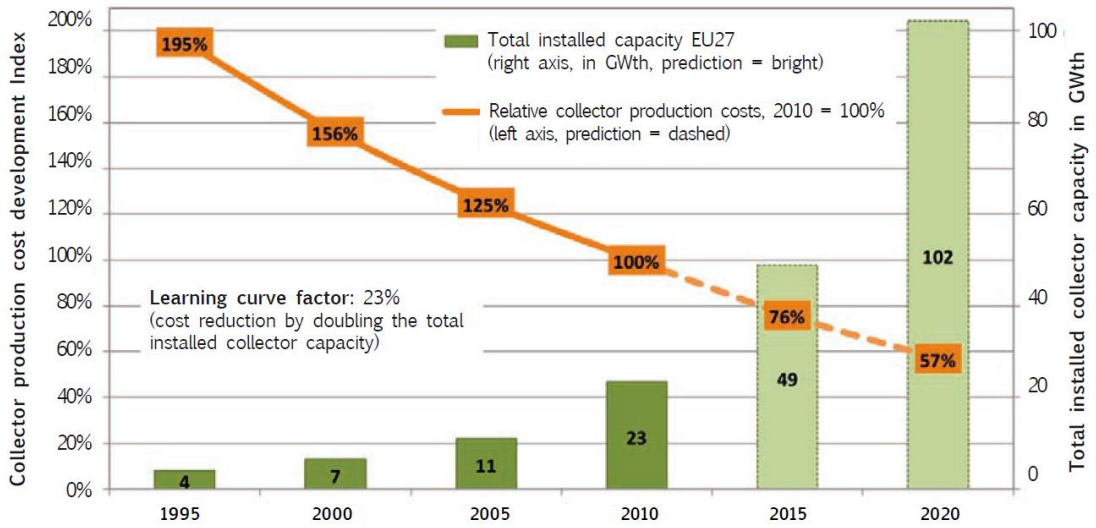
94 Interconnection (2013), "Euro Crisis Strains the Western European Window Industry, No Recovery Before 2014", May, www.interconnectionconsulting.com.

95 While conventional photovoltaic panels are installed on rack mount systems placed on buildings, BIPV integrate the electricity generation function to another product and replace conventional building materials in parts of the building envelope such as the roof, skylights, or facades.

façade and roof elements) and thus make retrofitting faster, more resource-efficient and more user-friendly start to appear on the market[96].

Cost reduction is also observed for efficient technical building systems (such as solar technologies or geothermal heat pumps), which are getting cheaper and more performing every day (Figure 6, Figure 7, and Figure 8).

Figure 6: Collector production costs development for high-efficient flat plate solar thermal collector panel of about 2.2 to 2.5 m² gross collector area manufactured in Europe (Source: solrico & trenkner consulting). Based on a learning factor of 23%, derived from these historical data, cost reduction projections are calculated up to 2020 based on market expectations of the National Renewable Energy Action Plans (NREAPs).



[96] Cf. for example the results of the e2rebuild project (http://www.e2rebuild.eu/), which developed industrialised energy efficient retrofitting of residential buildings in cold climates

Figure 7: Development of geothermal heat pump system first cost, heat full cost, and electricity consumption of geothermal heat pump systems in the residential sector in Central Europe (Germany, Austria, Switzerland, Luxembourg) (Source: European Technology Platform on Renewable Heating and Cooling, *"Strategic Research and Innovation Agenda for Renewable Heating & Cooling"*)

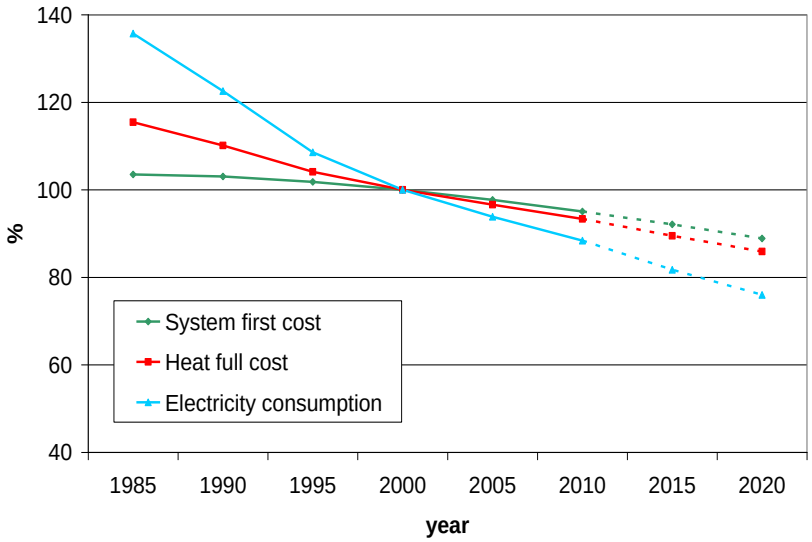
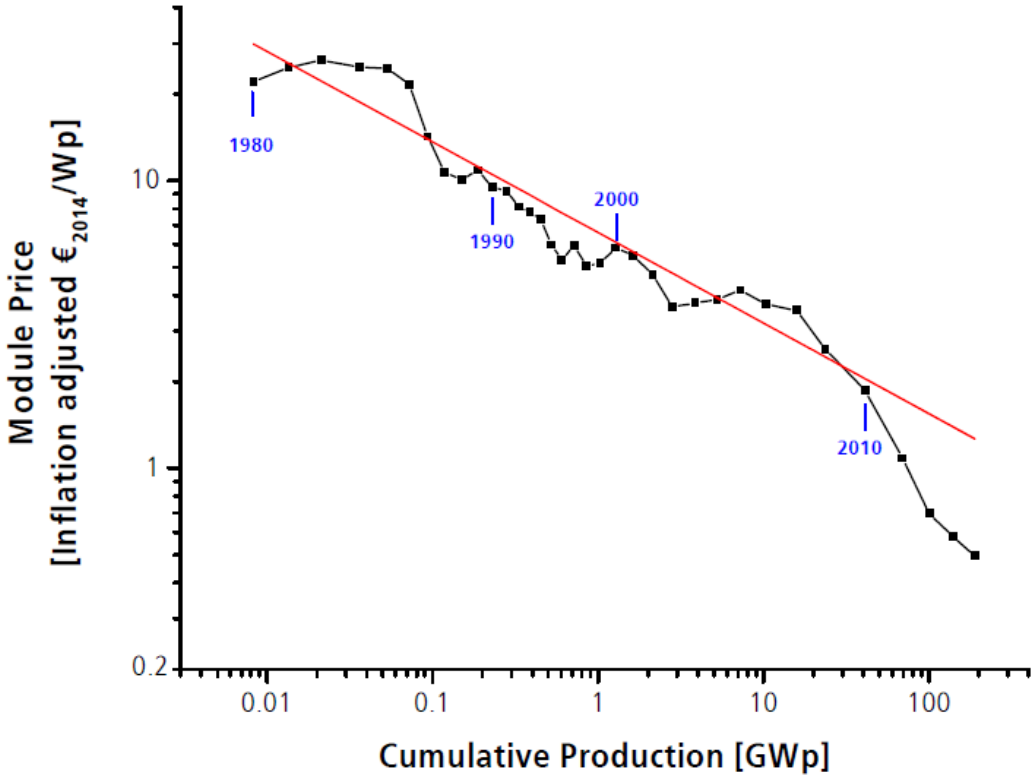


Figure 8: Price Learning Curve, including all commercially available photovoltaic technologies (Source: Fraunhofer Institute for Solar Energy, 2015 Photovoltaics report).



The impact of metering provisions in the electricity[97] and gas[98] Directives fostered cost-benefit analysis and supported the development of, *inter alia*, building automation systems, smart meters, demand forecasting software and smart grids. The development of key enabling technologies for "smart buildings" is no longer a technical barrier. The technology is well established:

- sub-metering has been available for many years;
- sensors have become cheaper and more reliable;
- Building Energy Management Systems (BEMS) are increasingly used.
- Data communication (internal and external) and user-friendly displays can be integrated with BEMS or smart meters, although a standard protocol for data exchange may have to be developed.

Standard data formats and transmission protocols still have to be agreed to ensure interoperability between devices and equipment from different manufacturers and the networks infrastructure, further work has to be done to agree standard data formats and transmission protocols.

Such developments could be pursued at EU level as technical projects or in standardisation committees.

These developments offer an opportunity to reconsider the design of energy efficiency measures for buildings by means of new technologies, improving comfort for the occupant and better preparing individual buildings to their more active integration/participation in the energy system (e.g. through demand response, renewable energy production and storage in buildings).

These issues are also addressed in parallel freestanding evaluations of the impact of energy legislation in the areas of (a) metering and billing and (b) demand response, framed in the broader discussion of the Market Design Initiative.

[97] Directive 2009/72/EU of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

[98] Directive 2009/73/EU of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC

Annex 9 EVALUATION OF THE EFFECTIVENESS

The effectiveness of the EPBD for the households and services sector was approached through two different means:

- Using the Odyssee-Mure decomposition tool[99], retained as the main reference to estimate the additional savings observed since the 2007 baseline. ;
- Observing the final energy consumption and GHG emission trends in order to detect the effects of the EPBD.

Methodological limitations are acknowledged and both approaches do not permit to fully segregate and precisely quantify the specific contribution of the EPBD:

- As developed in Section 5.3, the EPBD and the broader economic context and the action taken by the EU and by Member States to improve this context have intermingled effects;
- Other EU policies working in synergy with the EPBD may have influenced the observed trends, e.g. national measures including those adopted pursuant Directive 2006/32/EC on energy end-use efficiency and energy services. On the other side, by requiring the setting of minimum standards, the EPBD is also having an influence on the effectiveness of these other measures.

1. Estimation of energy savings with the Odyssee-Mure decomposition tool

48.9 Mtoe energy savings resulting of EU policies have been achieved in total:

- 41.4 Mtoe in the residential sector (of which 36.6 Mtoe for space heating only),
- 7.5 Mtoe in the service sector.

These figures seem to be in line with the 2008 Impact Assessment supporting the adoption of the EPBD and indicate that the Directive is likely to deliver the expected 60–80 Mtoe energy savings by 2020.

1.1. Households/residential sector

Apart from climatic conditions, energy consumption developments in households are influenced by various factors:

- Change in number of occupied dwelling ("more dwellings");
- More appliances per dwelling" (electrical appliances, central heating);
- Change in floor area of dwelling for space heating ("larger homes");
- Other effects (mainly change in heating behaviour);
- Finally, energy savings;

After neutralising the effects of the other factors, as shown in Figures 9 and 10, the energy savings resulting of EU policies in the household sector over the period 2007-2014 are estimated at 41.4 Mtoe (of which 36.6 Mtoe for space heating only).

This efficiency progress encompasses:

- Heating: unit consumption per square meter at normal climate (koe/m²),

[99] http://www.indicators.odyssee-mure.eu/decomposition.html

- Water heating: unit consumption per dwelling with water heating,
- Cooking: unit consumption per dwelling,
- Large electrical appliances: specific electricity consumption, in kWh/year/appliance.

Figure 9: Decomposition of the variation of Households' consumption - European Union - Mtoe (2007-2014) (Source: Odyssee database, http://www.odyssee-mure.eu/)

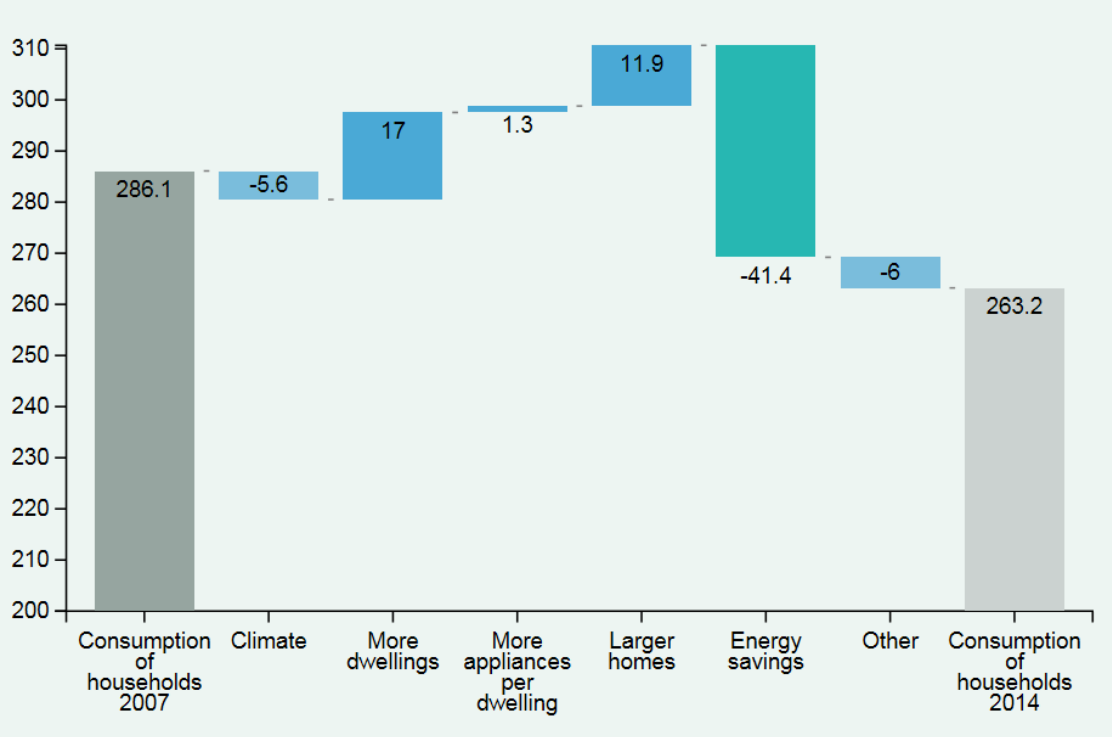
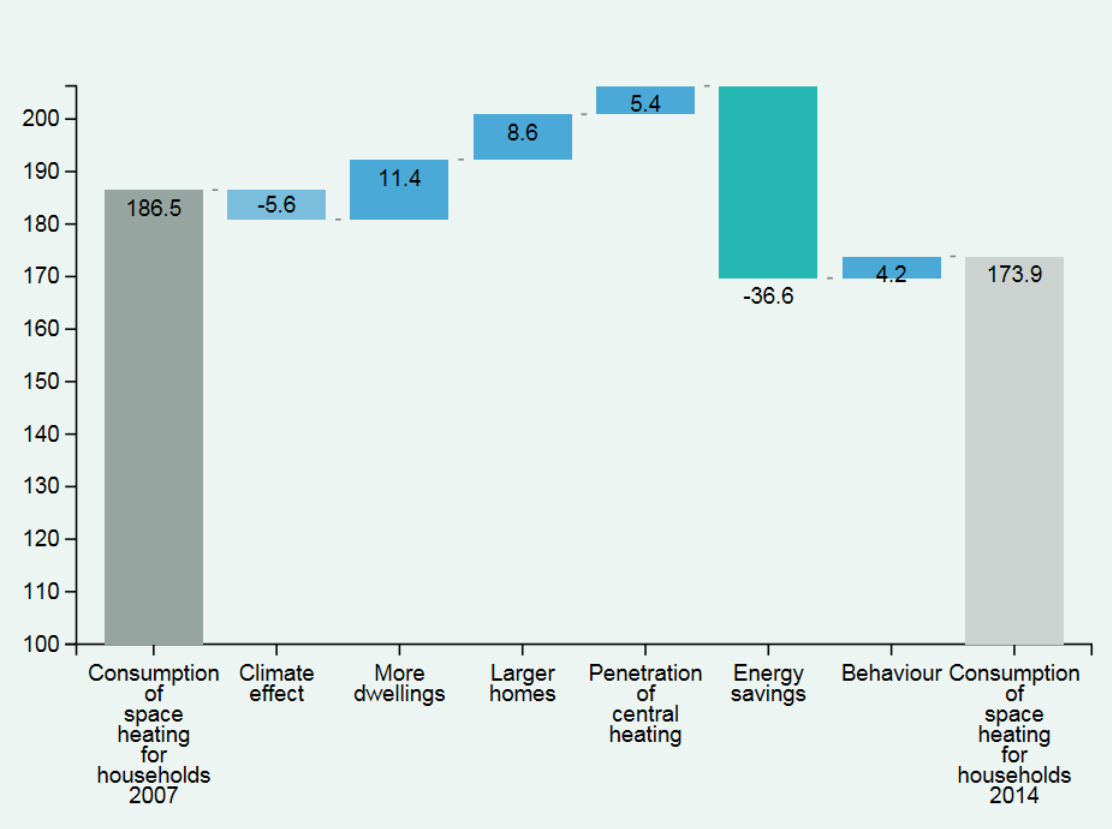


Figure 10: Decomposition of the variation of Households' space heating consumption - European Union - Mtoe (2007-2014) (Source: Odyssee database, http://www.odyssee-mure.eu/)



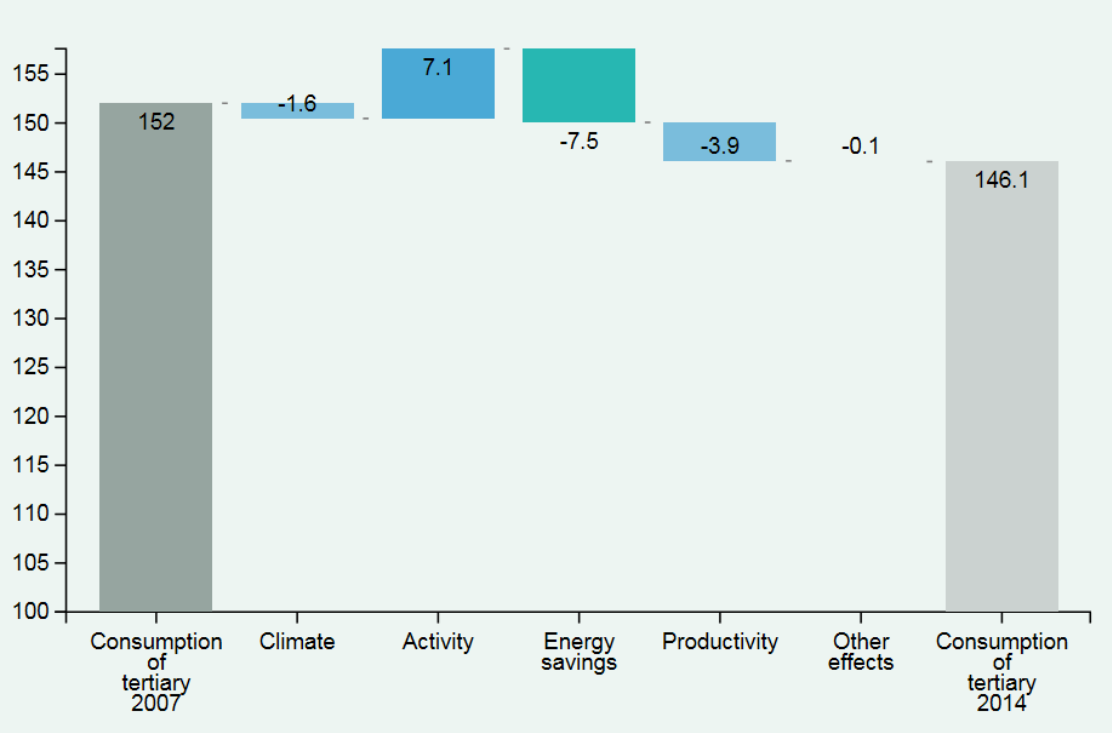
1.2. Tertiary/non-residential sector

Apart from climate, energy consumption developments in services are influenced by three factors.

- Change in economic activity, measured with the value added (“activity effect”);
- Energy savings, measured from changes in energy use per employee;
- Changes in labour productivity, i.e. changes in the ratio value added per employee ;
- Other effects, mainly behavioural effects.

After neutralising the effects of the other factors as shown in Figure 11, the energy savings resulting of EU policies in the service sector over the period 2007-2014 are estimated at 7.5 Mtoe.

Figure 11: Decomposition of the variation of service sector consumption - European Union - Mtoe (2007-2014) (Source: Odyssee database, http://www.odyssee-mure.eu/)



2. Analysis of final energy consumption trends

As detailed below, on average, the final energy consumption per square meter is still very high (final energy consumptions of 175kWh/(m².year) for residential buildings and around 300kWh/(m².year) for non-residential buildings) and decreasing very slowly, by 3.8kWh/(m².year) in the household sector, 5.2kWh/(m².year) in the service sector.

The final energy consumption per square meter is mainly driven by improvement of final energy consumption for space heating, around 125kWh/(m².y), which follows a similar trend at around 72% of the total final energy consumption (82% for space and water heating). For comparison:

- Nearly zero-energy buildings will typically have energy needs for space heating around 15-30kWh/(m².y),
- Major renovation of existing buildings can typically reduce the energy needs for space heating down to 50-70kWh/(m².y), at cost-optimal level.

A clear inflexion in final energy consumption can be observed from 2007 onwards compared to the observed trend pre-2006, application date of the Directive 2002/91EC. This suggests correlation between the EU intervention and the realised savings and emissions reduction.

Despite the fact that final energy consumption occur mainly within the EPBD scope (space heating and cooling and domestic hot water) and that the change of trend seems to coincide in terms of timing with the application of Directive 2002/91/EC, other EU policies working in synergy with the EPBD may have influenced the observed trends, e.g. national measures including those adopted pursuant Directive 2006/32/EC on energy end-use efficiency and energy services. On the other side, by requiring the setting of minimum standards, the EPBD is also having an influence on the

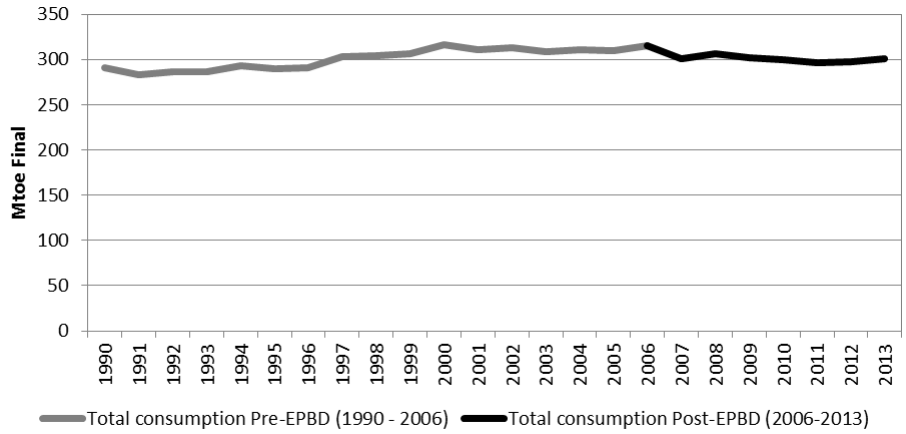
effectiveness of these other measures. This makes it impossible to precisely segregate and quantify a specific contribution of the EPBD to these savings.

The positive influence of the EPBD on this additional improvement cannot be denied either. Moreover, with its proposal for revision of the 2002 Directive in November 2008, the Commission gave a clear message of continuity and reinforcement. The main principles, objectives and most provisions were maintained, facilitating the continuation of national transposition and implementation efforts. Therefore, although not observable yet, a continuation of the trend in final energy consumption is the least that would be expected post-2013 as a result of the approach taken with the recast of 2010.

2.1. Households/residential sector

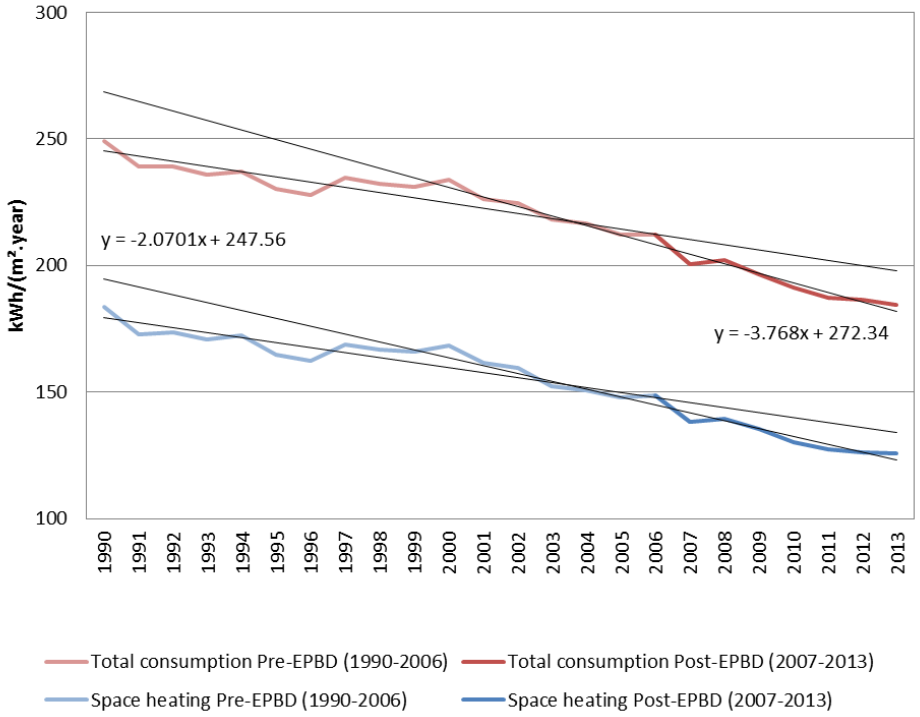
From 1990 to 2013, the climate corrected annual final energy consumptions in the residential sector, remains stable around 300 Mtoe, despite different factors (Cf. above decomposition) pushing for an increase of consumption (Figure 12).

Figure 12: Annual final consumption for the residential sector (climate corrected) (Source: Odyssee database, http://www.odyssee-mure.eu/)



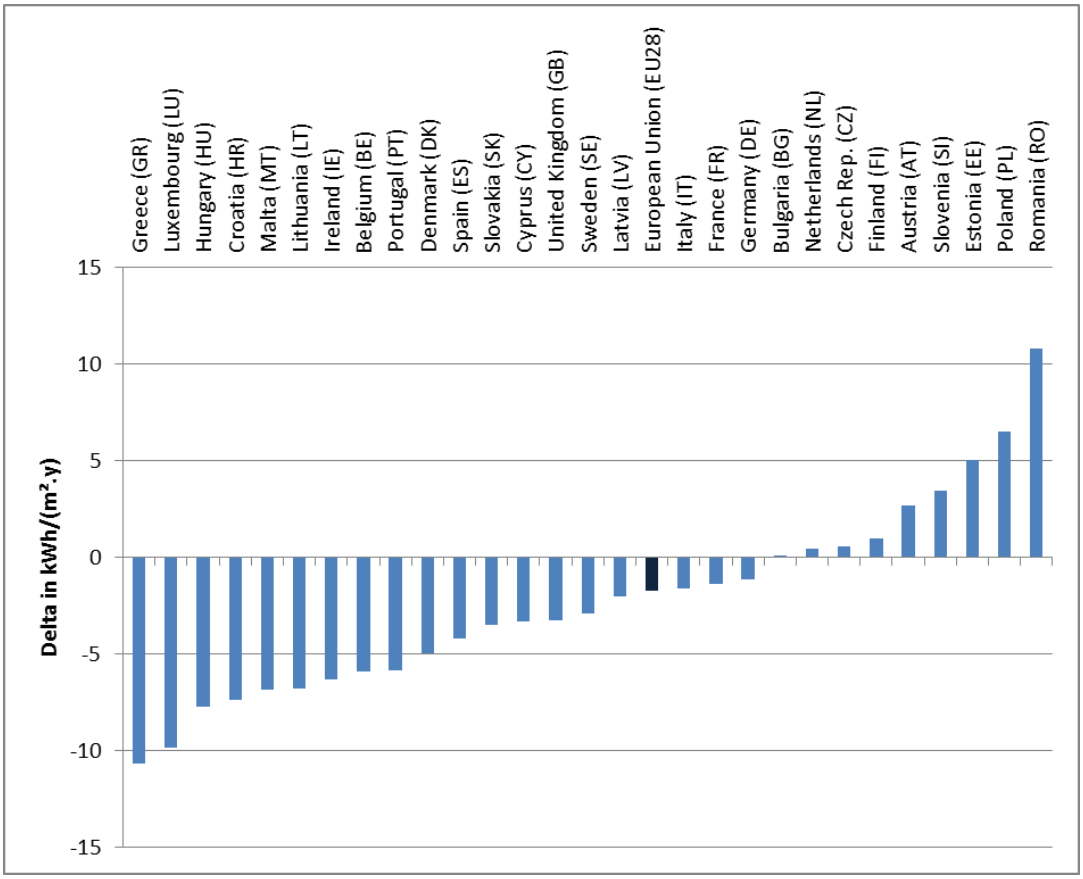
The observation of the trends of annual final energy consumption per square meter in residential building before 2006 and after 2007 can be used to approach the effect of the EPBD. At EU level, it can be observed that up to 2006, after climate correction, the average final energy consumption in the residential sector was decreasing on average by 2.1kWh/(m².y) each year. From 2007 to 2013, inclusive, this decrease was quicker, on average by 3.8kWh/(m².y) and appears to be maintained overtime (Figure 13). This can be materialised a net delta of -1.7kWh/(m².y). The negative sign indicates a quicker decreasing slope after 2007 compared to before 2006.

Figure 13: Annual final consumption per m² and per year in residential buildings, total and for space heating (climate corrected) (European Commission, based on data from Odyssee database, http://www.odyssee-mure.eu/)



A similar analysis was done at national level. In most Member States, the trend changed towards delivering more energy savings per square meter per year (Figure 14), meaning that the observed decrease is quicker after 2007 compared to the pre 2006 general trend, sometimes much more significantly than the EU average change of trend.

Figure 14: Difference in the change of the evolution trend of the annual final energy consumption per square meter in the residential sector between the trend observed after 2007 and the trend observed before 2006)



The few Member States with an opposite change are also Member States that had a quick decreasing trend before 2006 (Figure 15). However, these Member States also have a relatively higher consumption than the EU average but also compared to some of their neighbouring countries with similar climate intensity.

Figure 15: Evolution trend of the annual final energy consumption per square meter in the residential sector between the trend observed after 2007 and the trend observed before 2006.

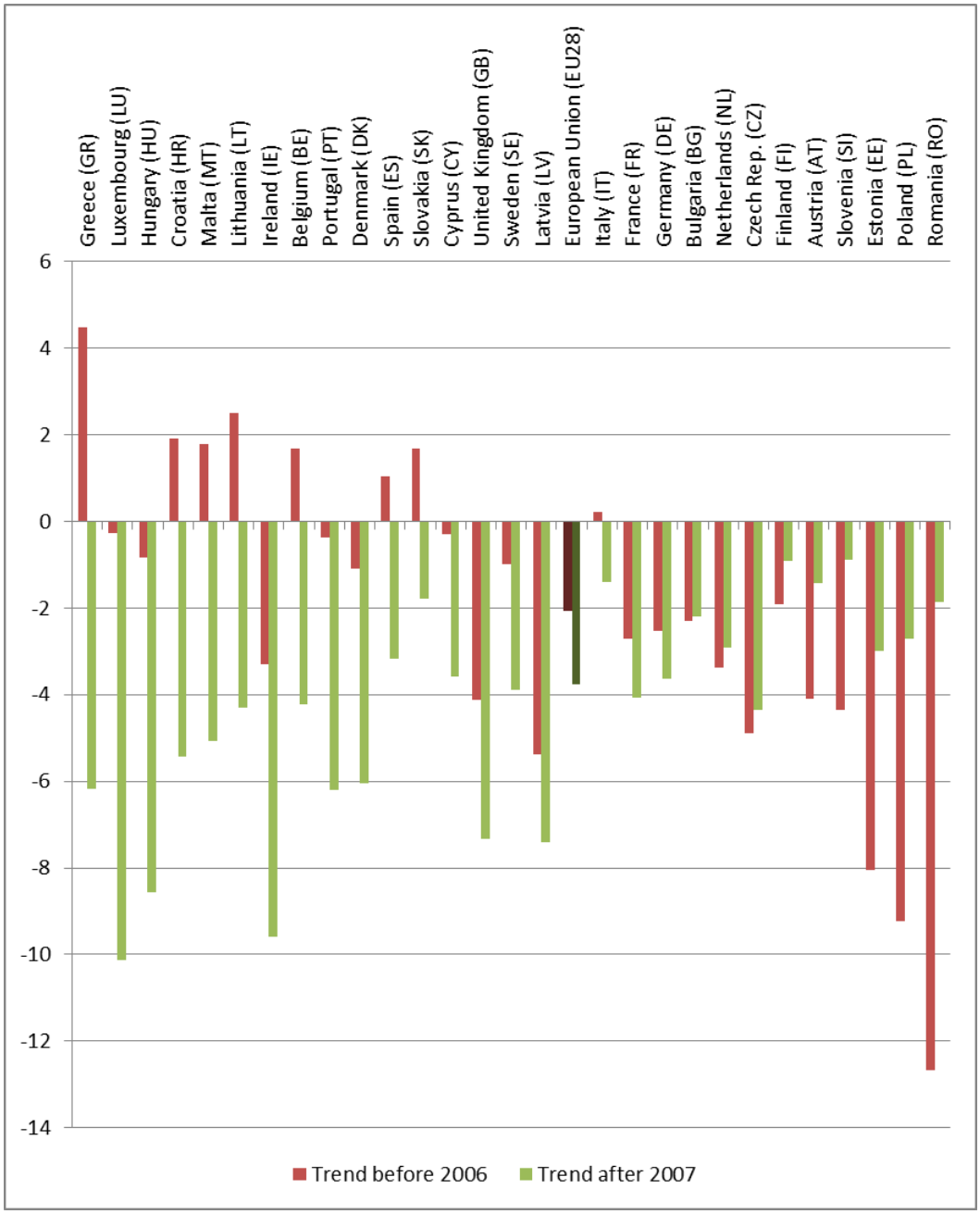
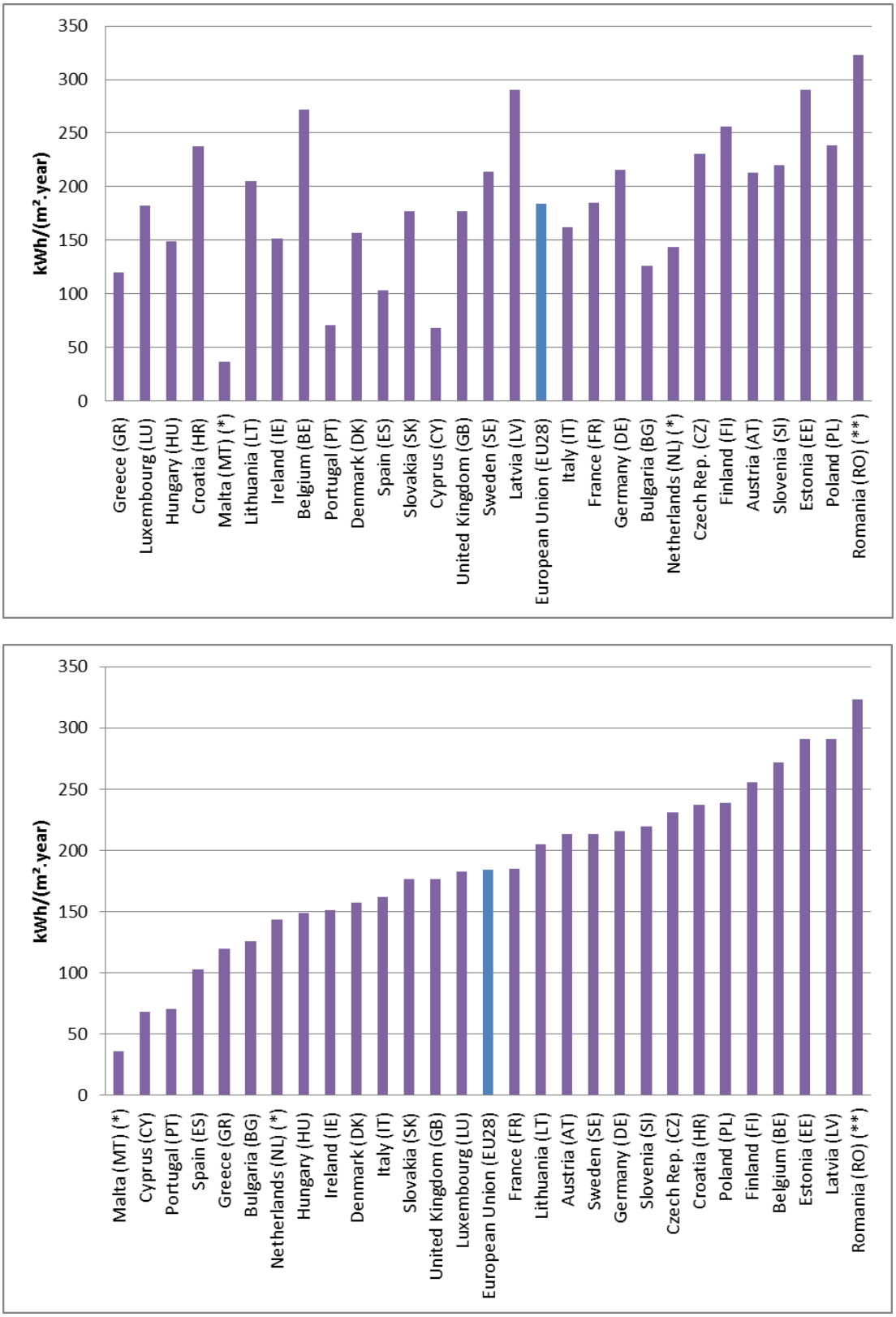


Figure 16 shows the latest known annual final energy consumption per square meter in the residential sector for EU28 Member States with two different layout: in the same order as in Figure 14 and Figure 15; and in ascending order.

Figure 16: Latest known annual final energy consumption per square meter in the residential sector (2013 value for all Member States, except (*) 2012 and (**) 2011)

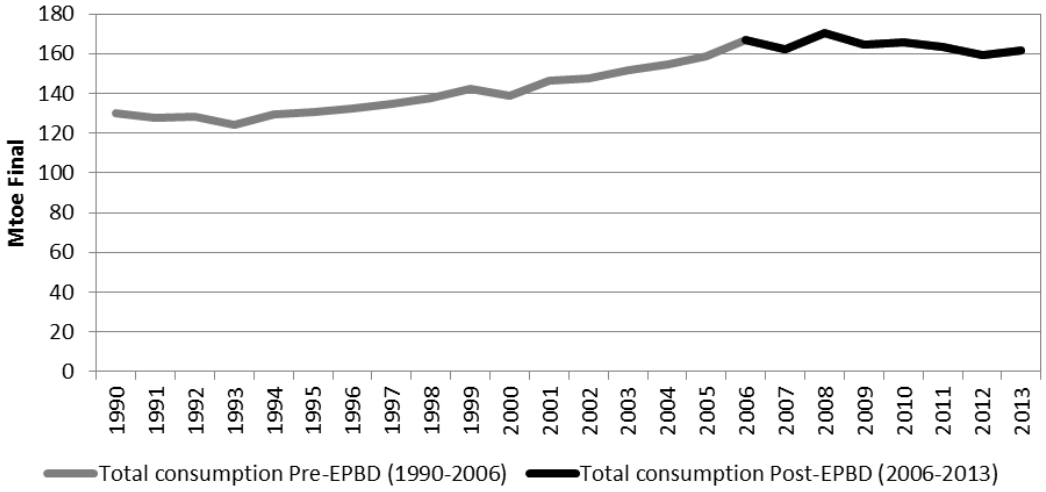


2.2. Tertiary/non-residential sector

From 1990 to 2013 (latest available data), the climate corrected annual final energy consumptions in the non-residential sector, remains stable around 160 Mtoe, despite

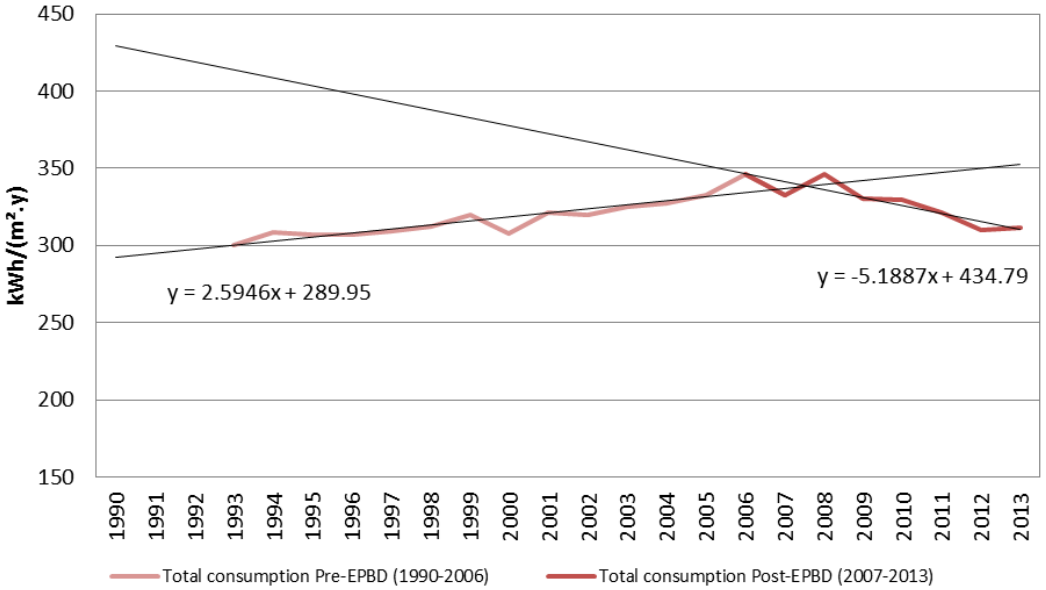
different factors (Cf. above decomposition) pushing for an increase of consumption (Figure 17).

Figure 17: Final consumption for the service sector (climate corrected) (Source: Odyssee database, http://www.odyssee-mure.eu/)



The observation of the trends of annual final energy consumption per square meter in residential building before 2006 and after 2007 can be used to approach the effect of the EPBD. This can be materialised a net delta of -7.7833kWh/(m².y). The negative sign indicates a quicker decreasing slope after 2007 compared to before 2006. (Cf. Figure 18).

Figure 18: Total annual final consumption per m² and per year in non-residential buildings (climate corrected) (European Commission, based on data from Odyssee database, http://www.odyssee-mure.eu/)



Due to lack of disaggregated data (energy use by end use), the fraction of these energy efficiency gains within the EPBD scope (i.e. for space and water heating, cooling, ventilation and lighting) cannot be established independently from other energy efficiency gains, e.g. from electric appliances, or other factors such as building

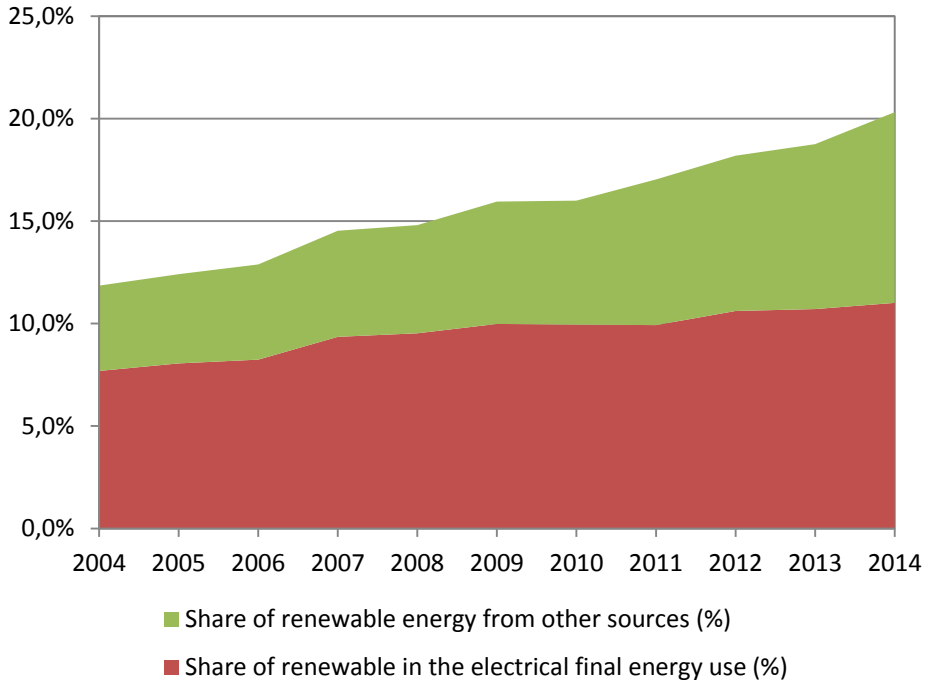
occupancy rates. In particular, the climbing slope from 1990 to 2006 is clearly driven by an increase of electricity use in tertiary buildings. At least two factors can explain this increase of electricity use: the development of air-conditioning, to avoid overheating or provide additional comfort, and the increase of computer usage in the service sector. In addition to the effect of the EPBD, the decrease after 2007 is certainly also a result of national and other EU policies, e.g. on energy efficiency of products and in particular light bulbs, ventilation units, and air-conditioning systems.

The absence of data on floor areas of the national non-residential building stocks does not allow the derivation of the national trends in the non-residential sector.

3. Renewable energy

At EU level, the 2014 share of renewables in final energy consumption in households and services is estimated at 20.3%, of which 9.3%-points is renewable electricity and 11.0%-points for other renewable sources (Figure 19). The share of renewable electricity in households and services assumes that the overall electricity mix can be applied to individual sectors.

Figure 19: Cumulated share of renewables in the total final energy use for households and services (Source: Eurostat, ref. indicator "nrg_ind_335a")



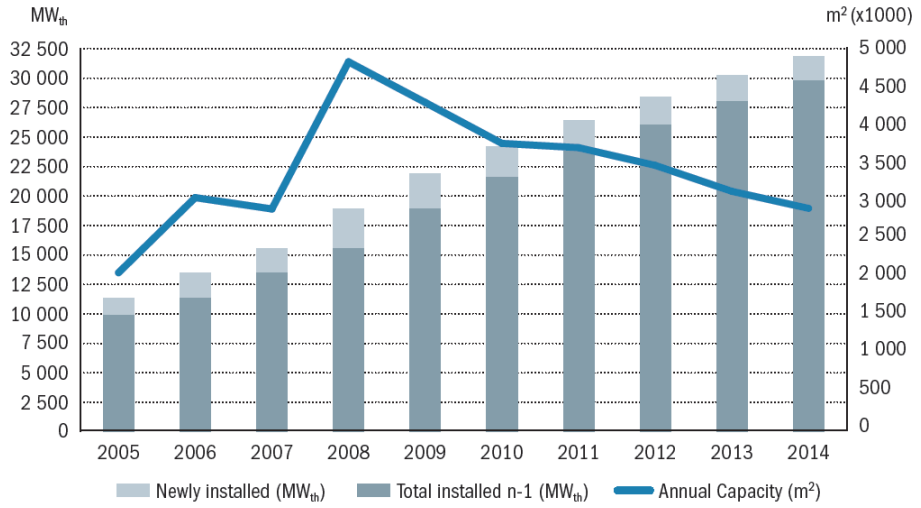
An additional 1.3%-point could be added on top of the 20.3%, assuming that the 17.7% share of renewables in the energy use from derived heat in 2014 could be used for the household and service sectors only.

Supported by policies, a peak in annual solar photovoltaic, for the generation of electricity, installed capacity was observed in 2014, with a total installed capacity of 86,636 MW, of which around 50 % consists of residential and commercial scale installations[100].

[100] "Global market Outlook", 2015, Solar Power Europe

Solar thermal collectors are another typical example of renewable technologies installed on buildings. As Figure 20 shows, the installed capacity is steadily increasing and the regulatory framework for buildings is not used to explain the contraction of sales post-2008 but rather low gas prices, difficult access to finance for consumers, slow-moving construction sector, less public support schemes for solar thermal and competition from other energy sources, namely those with more attractive market incentives[101].

Figure 20: Solar Thermal Market in EU28 and Switzerland MWth Total and Newly Installed Capacity (glazed collectors) (Source: "Solar thermal markets in Europe - Trends and Market Statistics 2014", June 2015, ESTIF)



The contribution of the Directive 2002/91/EC and of the EPBD to these increases cannot be exactly determined. Directive 2009/28/EC more specifically promote the increase of renewable energy in general where the EPBD, with the tightening of minimum requirement implies a technology neutral approach, based on cost effectiveness. However, it was established[102] that tightened minimum energy performance requirements naturally stimulate the cost-effective introduction of renewable energies in buildings and that the construction of nearly zero-energy buildings will naturally require the introduction of on-site renewable energy sources.

4. Greenhouse gas emissions and air pollution

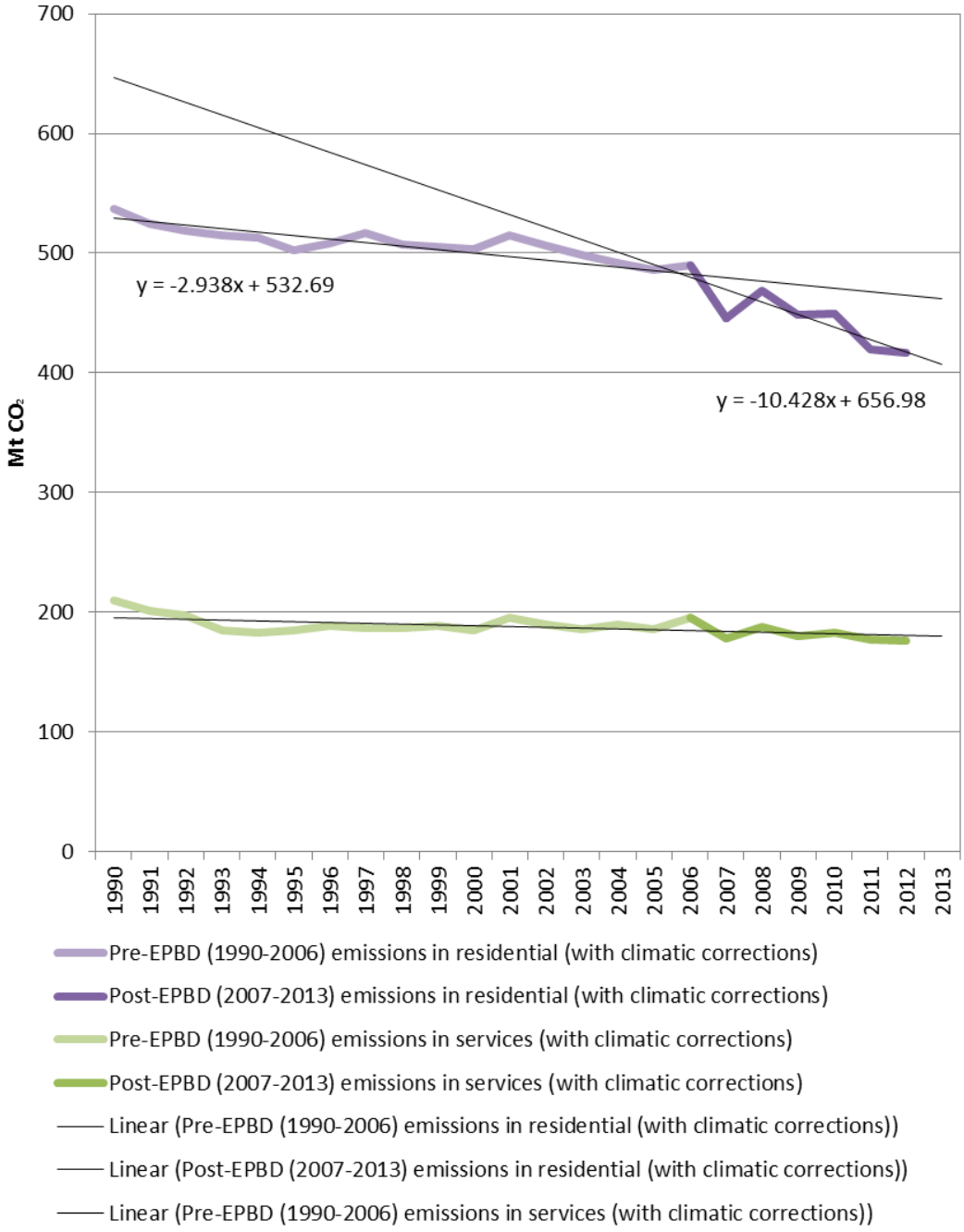
A similar analysis to the analysis performed on final energy consumptions shows, a clear change of trends in the residential sector appears post-2007 whereas the trend remains continuous for the service sector, before and after 2007 (Figure 21). Between 2007 and 2013, climate corrected energy consumption per dwelling dropped by around 5% (from 1.50 toe/dwelling to 1.42 toe/dwelling) and climate corrected CO_2 emissions by 10% (2.22 tCO_2/dwelling to 1.98 tCO_2/dwelling)[103]. From this change of trend, and compared to the 2007 baseline of the EPBD, additional greenhouse gas emission for 2013 can be estimated at 63$MtCO_2$, for the residential sector only (i.e. 8% of the 1990 total emissions of household and service sector).

[101] Solar thermal markets in Europe - Trends and Market Statistics 2014, June 2015, ESTIF

[102] Towards nearly zero-energy buildings- Definition on common principles under the EPBD (http://ec.europa.eu/energy/sites/ener/files/documents/nzeb_full_report.pdf), European Commission (written by Ecofys).

[103] Source: Odyssee database, http://www.odyssee-mure.eu/

Figure 21: Total greenhouse gas emissions in the residential and service sectors (climate corrected) (European Commission, based on data from Odyssee database, http://www.odyssee-mure.eu/)



5. Investments and job creation

In 2014, the total costs associated with energy related upgrade (e.g. insulation, heating system upgrade, etc.) are estimated around €120 bn. Based on the assumption of approximately 6 jobs created and maintained for every €1 million constant yearly investment in the existing building stock in the form of energy renovation work, this leads to 720,000 direct and indirect jobs[104] associated with the energy renovation of the EU building stock.

[104] This figure is estimated with a conservative assumption of around 6 direct and indirect jobs per million euro invested. More details can be found in: Assessing the Employment and Social Impact if Energy Efficiency, 2015, Cambridge Econometrics, Warwick Institute for Employment Research and ICF International. For

The supporting study for the on-going Fitness Check on the construction sector[105] estimates that new business opportunities generated by EU energy efficiency legislation at some € 124 billion over the 2010-2014 period, i.e. on average € 24.8 billion per year, equivalent to 148,800 created or maintained jobs in the construction sector.

example, Janssen and Staniaszek in "How many jobs? A survey of the Employment Effects of Investment in Energy Efficiency of Buildings" derive an average 19 direct and indirect jobs per million euro invested.

[105] Supporting study for the Fitness Check on the construction sector: EU internal market and energy efficiency legislation, 2016, European Commission (Written by Economisti Associati, Milieu, CEPS, BPIE, DBRI)

Annex 10 EVALUATION OF THE EFFICIENCY

1. Evaluation of the administrative costs for implementing bodies.

The recast used Directive 2002/91/EC as the starting point and 'backbone' for the revision. The costs associated with the new measures of the recast were analysed and found to be relatively low compared to the benefits and returns. For example, abolishing the 1000 m² threshold on an EU scale would lead to €8 billion per year additional investments but would trigger €25 billion per year energy cost savings by 2020. The impact on administrative burden was considered limited for this specific provision.

The 2010 revision chose to ensure continuity of national efforts to transpose and implement Directive 2002/91/EC. The main provisions, scope and structure were therefore kept in a conscious effort to ease transposition of the 2010 Directive and limit related administrative burden.

The following costs, leading to a total cost of 160.8M€ for the 2011-2015 period (including Norway) were reported by the Member States in the context of the Concerted Action. This cost is considered reasonable in comparison with the benefits associated with the achievements of the EPBD

Table 2: Estimate the administrative costs linked to the EPBD transposition and implementation in the 2011-2015 period (e.g. prepare relevant legislation, EPCs, Q&A, campaigns, etc.)

(k€)	staff costs	services/studies	campaigns	total (k€)
AT	4092	6580	2012	12684
BE	5600	21225	0	26825
BG	694	0	0	694
CY	1650,6	93	5,7	1749,3
CZ	0	893,5	1702,9	2596,4
DE	0	3447	464	3911
DK	9000	0	18200	27200
EE	0	487	0	487
ES	0	2038,5	85+9,5	2038,5
FI	0	2200	25	2225
FR	49	2021	0	2070
GR	240	270	0	510
HR	123	1120	0	1243
HU	141,8	567,2	0	709
IE	0	4600	0	4600
IT	0	0	8000	8000
LT	330	423	35	788
LU	0	600	2400	3000
LV	240	50	0	290
MT	3120	583	0	3703
NL	10626	0	0	10626
NO	1800	6600	0	8400
PL	540	74,6	0	614,6
PT	10800	2700	0	13500
RO	0	400	0	400
SE		8000		8000
SI	200	0	60	260
SK	45	764,5	0	809,5
UK	7200	5700	0	12900

Total: **160,8 M€**

2. Evaluation of the efficiency of the different provisions of the EPBD

The evaluation of efficiency was further conducted for its four main pillars described in Annex 3.

2.1. Efficiency in adopting a method to determine the energy performance of buildings

35 different national/regional calculation methodologies for the determination of the energy performance of buildings were identified at national/regional level. These calculation methodologies are adopted in different manners and can hardly be grasped by experts outside of the country where it was adopted. To perform their technical analysis, a consortium of 28 European experts was necessary[106]. Furthermore, due to these different underpinning calculation methodologies, absolute levels of minimum energy performance values in building codes cannot be directly compared across Member States.

These different methods lead to different energy performance ratings, beyond the justifiable specific local conditions. Only 15 of the 35 methodologies are considered to be fully reliable for the calculation of the primary energy demand and compliant with Annex I of the Directive. Non-compliance was often due to national methodologies not taking the positive influence of highly efficient technical solutions, such as efficient district or block cooling systems or on site cogeneration, into account. In addition to the subsequent barrier to their emergence[107], missing technical systems cannot be evaluated in cost-optimal calculations, which are no longer technology neutral.

Even when calculation methods cover highly efficient systems, Member States may have different approaches. For instance, electricity production from photovoltaic systems (PV) is generally accepted in most Member States, but the way electricity is accounted for in the national calculation procedures varies. From a sample, 17 out of 20 Member States allow inclusion of electricity from PV, while 12 allow electricity from local wind-turbines and combined heat and power (CHP) to be included in the calculated energy performance of buildings. 9 of these 20 Member States also allow the inclusion of electricity from hydropower. More or less the same differences and approaches apply for RES-based heating and cooling production[108].

These differences result in market fragmentation and possible barriers to certain technologies, limiting the cost reduction potential for existing technologies and increasing costs of development of new efficient technologies.

The conclusion must be made that the common general framework set out in the Directive is insufficiently detailed to achieve the initial ambition to facilitate the comparison of various buildings' investments throughout the EU for prospective investors and make it easier for designers and constructors to apply similar standards in other Member States (as presented in the proposal for Directive 2002/91/EC[109]).

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106 Technical assessment of national/regional calculation methodologies for the energy performance of buildings, 2015, European Commission (written by CSTB/TSUS)

107 ibid.

108 Implementing the Energy Performance of Buildings Directives, 2015, Concerted Action EPBD

109 COM(2001)0226 final of 15 May 2001, proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings

The rationale behind addressing the integrated energy performance of buildings remains relevant. The integrated energy performance considers, in addition to the quality of insulation of the building, heating installations, cooling installations, energy for ventilation, lighting installations, position and orientation of the building, heat recovery, active solar gains and other renewable energy sources. The emerging market for building integrated renewable generation technologies adds to the initial motivations for this choice.

The current determination of the energy performance, in typical use conditions, is also relevant to provide appropriate market information for property valuation[110] and enables the engagement of owners and investors (responsible for energy performance of buildings), to ensure compliance with legal requirements, or constructors and financial institutions, to establish more stringent contractual requirements.

Different stakeholder groups, e.g. financial institutions, require information that makes sense to them and that can support informed decisions. In this context, information on actual energy consumption complementary to information on the asset value of buildings, could certainly benefit from technical progress on better ICT, e.g. through the use of central databases to collect information and redistribute statistical data[111].

2.2. Efficiency in the setting, application and enforcement of minimum energy performance requirements

Decisions made during a buildings' design stage will structurally determine energy consumption over much of their lifetime. Some energy efficiency improvements are possible only during construction or by major refurbishment, likely to happen after several decades. The setting of energy efficiency requirements in building codes is therefore one of the most important single measures for energy efficiency in buildings.

The provisions of the 2002 and EPBD had a direct influence on minimum standards applied to new buildings and to existing buildings undergoing renovation. As a result of these directives, a strengthening of minimum energy performance requirements in building codes is clearly observed[112]. Due to different underpinning national/regional calculation methodologies, absolute levels of minimum values cannot be directly compared between countries. However in relative terms, the observed tightening between 2005 and 2013 was for example 66% for new buildings in France, and 60% for new and existing residential buildings in Ireland.

The EPBD aimed at ensuring a similar minimum level of ambition of minimum energy performance requirements across Member States. For this purpose, the European Commission established a comparative methodology framework for calculating cost-optimal levels of energy performance requirements for buildings and building elements[113]. Although demanding, the cost-optimal calculation framework is positively

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110 e.g. IEE project RenoValue is developing a training toolkit on building energy performance for property valuation professionals, building upon EPCs in particular. See http://renovalue.eu/

111 Under the H2020 Energy Efficiency calls in 2014 and 2015, the EE11 topic looked at using ICT tools to promote energy conscious consumer behaviour. In some of the selected ongoing projects such as the Greensoul project and the Orbeet project, enhanced displays and information through mobile apps and serious games is provided to the consumer and user of the building in order to influence its behaviour towards energy use.

112 Implementing the Energy Performance of Buildings Directives, 2016, Concerted Action EPBD

113 Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by

considered by stakeholders, including by national authorities, as an efficient instrument in ensuring the right balance between self-benchmarking of requirements in place and flexibility to consider different national contexts.

The analysis of the first round of cost-optimal calculations revealed significant gaps[114] between the current level of requirements and the cost-optimal level for half of the Member states[115]. As described in Article 4 §1, last subparagraph, these gaps must be reduced "by the next review" that should take place within 5 years after the 31 March 2013 deadline[116], i.e. at the latest on 31 March 2018. This process (cost-optimal calculations – review of minimum requirements) is an iterative process that will further result in a periodic tightening of minimum requirements, including beyond 2020. As an example, in Slovakia the 2013 minimum energy performance requirements for apartment blocks will be cut by half in 2016 due to the results of the calculation of the cost-optimal levels.

Progress by individual Member States towards setting cost-optimal levels of minimum energy performance requirements is presented in a recent progress report[117].

From the comparison of reported cost-optimal levels and minimum energy performance requirements, it can be concluded that roughly half of the Member States have set minimum performance requirements which are below the 15% threshold. For example, in Denmark, Finland and Spain the average gaps between cost-optimal levels and minimum requirements for all building categories (i.e. new building, major renovations, and building elements) and types (i.e. single family houses, apartment buildings and non-residential buildings) are below that threshold.

This flexibility may be challenging as the technical ability to respond to some of the requirements of the Directive significantly varies from one Member State to another. This concerns in particular the setting of minimum requirements for technical building systems and the development and adoption of a calculation methodology compliant with the general framework of Annex I of the Directive. These national and regional calculation methodologies are the corner stone of both minimum energy performance requirements and certification of buildings.

Specifically for new buildings, the pathway towards nearly zero-energy buildings by 2020 is perceived as an important signal by the respondents to the public consultation that call for a similar vision for existing buildings.

The NZEB concept mobilised stakeholders towards a common path. The first progress report on nearly zero-energy buildings showed little progress made by the Member States in their preparations towards NZEBs by 2020[118]. At that time only 9 Member

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establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements

114 Gaps are considered significant when the minimum requirement is more than 15% higher than the cost-optimal level. If this gap cannot be justified, Member States have to plan the reduction of the gap within 5 years.

115 Assessment of cost-optimal calculations in the context of the EPBD, Ecofys, 19 November 2015

116 The Commission extended the original deadline of 30 June 2012 till 31 March 2013 to account for the time needed to develop and adopt the Commission Delegated Regulation.

117 Report from the Commission to the European Parliament and the Council – Progress by Member States in reaching cost-optimal levels of minimum energy performance requirements; COM(2016)464 final of 29 July 2016.

118 COM(2013) 483 final/2

States had submitted national plans. Despite the fact that an updated progress report in 2014[119] and information collected in 2015[120] showed clear improvement compared to the Commission progress report of 28 June 2013, it cannot be guaranteed that all new buildings will be NZEB by 2020, all over Europe[121]. This could delay the realisation of related benefits.

New buildings are not yet built at cost-optimal levels across the EU as the calculated optimal levels can be implemented by Member States within 5 years after the calculations were carried out. Minimum requirements are generally enforced at building permit stage, which means that buildings can be built with the standards into force at the time of granting the permit. This time lapse may be problematic for the achievement of the NZEB targets. In addition, compliance and enforcement gaps are contributing to not reaching cost-optimal levels and this is equally true when it comes to NZEB.

Evidence shows that Member States are falling short in their preparations to meet the NZEB target, mainly due to the need to adapt current practices well in time to ensure that all new buildings by the end of 2020 are NZEB. Such adaptation would mean in particular the swift adoption of detailed national definitions of NZEB where not yet available, or their reinforcement when needed, and assessing the need for adapting current permit practices to make sure that all new buildings by 2020 are constructed in accordance with NZEB standards.

Numerical indicators for NZEB standards are not fully comparable across Member States because different energy performance calculation methodologies are used. With this caveat, the available evidence shows that for residential buildings, most Member States aim to have a primary energy use not higher than 50kWh/m²/yr. The maximal primary energy consumption ranges between 33kWh/m²/y in Croatia (Littoral) and 95kWh/m²/y in Latvia with several countries (BE (Brussels), EE, FR, IE) aiming at 45 or 50kWh/m²/y.

The NZEB provisions naturally drive the use of renewable energy sources, notably on-site as the energy produced on-building reduces the primary energy associated with the delivered energy. While several Member States require a renewable energy share of the primary energy used or a minimum renewable energy contribution in kWh/m²/year, others use indirect requirement such as a low non-renewable primary energy use that can only be met if renewable energy is part of the building concept[122]. This flexibility allows adaptation to national circumstances and local conditions (building type, climate, costs for comparable renewable technologies and accessibility, optimal combination with demand side measures, building density, etc). The most frequently applied renewable energy systems in NZEB are on-building solar thermal and PV systems. Other renewable energy sources used in these buildings are geothermal (from ground source heat pumps) and biomass.

119 https://ec.europa.eu/energy/sites/ener/files/documents/Updated%20progress%20report%20NZEB.pdf

120 Synthesis report on the national plans for NZEBs, 2015, JRC

121 Communication COM(2013)483/2 of 17 October 2013 on Progress by Member States towards Nearly Zero-Energy Buildings

122 Towards nearly zero-energy buildings- Definition on common principles under the EPBD (http://ec.europa.eu/energy/sites/ener/files/documents/nzeb_full_report.pdf), European Commission (written by Ecofys).

The ZEBRA 2020[123] project is collecting data on the gradual deployment of NZEB in Europe. Figures on share of new dwellings built according to NZEB definitions ranged from few percentage points in several Member States to 28.1% in France, according to 2012 figures. However, data are only available for few Member States (8 Member States in 2012 and only 2 Member States in 2015). Additional information should become available through the development of the EU Building Stock Observatory.

Experience by Member States with practical examples of existing buildings that have an energy performance level in the expected range of NZEB[124], indicates an improvement of energy performance compared to current national requirements between 21% and 202%, with an average 74% improvement. The average additional costs compared to current national requirements is 208 €/m² or 11% of the total costs. However there are also buildings with zero additional costs and buildings with up to 473 €/m² or 25% of the total construction and technology costs. It must be noted though that some of these buildings are special demonstration projects or prototypes, and they may not be representative of future typical costs of NZEBs when these technologies become standard. Besides these averages across building types, NZEB apartment buildings reported that costs that were affordable or financially attractive to the tenants. Additional costs compared to conventional buildings were as low as 0 €/m² for one Croatian and one Finnish example, 20 €/m² for the Danish example, 27 €/m² for the Spanish example and 25 €/m² for a second Finnish example.

The analysis of cost-optimal calculations indicates that a smooth transition between cost optimality and NZEB is achievable. Furthermore, the feasibility of the NZEB standard is demonstrated by pioneer regions such as Brussels, where NZEB is the standard for new buildings and deep renovations since 2015. Further options for increasing the effectiveness of the measure are discussed by many respondents to the public consultation, i.e. better linking NZEBs *with EPCs*, making NZEB a specific certification class, and *with finance*, referring to NZEB in financial support schemes.

For existing buildings, an important modification introduced by the recast of the EPBD was the deletion of the 1000m² threshold for meeting national and regional minimum requirements when buildings undergo a major renovation and the inclusion of minimum energy performance requirements for simple retrofits of building elements, both as part of the building envelope (e.g. windows) and of technical building systems.

The effectiveness of measures on existing buildings and building renovation is strongly affected by lack of enforcement. Smaller renovations do often not require a building permit, rendering enforcement of minimum requirements practically impossible. Over three quarters of Member States are unable to report compliance rates for retrofitted building elements and when this is done, compliance rates are typically very low. Overall, annual energy savings achieved so far by Member States are approximately 42% lower than they would have been at 100% compliance with all minimum energy performance requirements[125].

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123 http://www.zebra-monitoring.enerdata.eu/overall-building-activities/share-of-new-dwellings-built-according-to-national-nzeb-definition-or-better-than-nzeb.html

124 http://www.epbd-ca.eu/outcomes/2011-2015/CA3-BOOK-2016-A-web.pdf

125 Energy Performance of Buildings Directive (EPBD) Compliance Study, 2015, European Commission (written by ICF International)

The case of requirements for existing buildings requires deeper analysis given that most of the cost-efficient potential that remains concerns building renovation. The Directive distinguishes:

- the case of major renovations for which energy performance requirements must be ensured and met for the building,
- the case of simple retrofits of building elements (below the major renovation threshold) for which minimum energy performance requirements of the replaced/retrofitted element only must be ensured.

Higher ambition on major renovations of existing buildings, regardless of their size, was justified by the specific opportunity to take cost-effective measures to enhance energy performance at the same time as other major refurbishments. It is generally accepted that the best moment for the introduction of more ambitious energy efficiency measures is when a building undergoes major renovation (of aspects other than energy), which is approximately every 25 years. At that stage, the relative additional investment needed is not high.

There is no consensus regarding a single best approach to regulate the renovation work. A holistic major renovation approach provides the greatest increases in energy efficiency, by matching all components with each other[126] but requires more investments to design the most cost-effective solution. On the other hand, requirements linked to building elements limit the burden, but are also more difficult to trace and enforce as they are often not linked to an obligation for building permit.

The Impact Assessment for the EPBD acknowledged that renovations are usually made 'step by step', and that those single steps should not trigger the major renovation threshold. However, the Directive does not provide tools to ensure that such elemental upgrades follow a consistent intervention logic over time. This gap was highlighted by the respondents to the public consultation and requires further analysis in the Impact Assessment.

The assessment of the first building long-term renovation strategies, submitted under Article 4 of the Energy Efficiency Directive (EED), showed that Member States need further guidance and support for quantification (setting of targets, expected energy savings and benefits) and forward looking aspects required to guide investments into building renovation. At individual level, building owners and occupants face a lack of information on how to plan and implement improvements in energy efficiency in buildings over time (e.g. optimal route for step by step energy renovation, timeline, costs, benefits and solutions to overcome the 'hassle factor' and/or intrusiveness of renovations).

For technical building systems (TBS), confusion has arisen about the interpretation of 'existing buildings', which is sometimes taken to mean only buildings that are undergoing renovation. The EPBD makes clear that regulations are needed for all TBS installations, whether or not the building is undergoing renovation. The EPBD requires that the regulations cover energy performance, proper installation, dimensioning, adjustment, and control.

[126] Energy efficiency in heating systems in industry and production, 2011, Deutsche Energie Agentur (DENA)

TBS must be considered at system level, which is distinct from whole building performance (as measured for EPCs) and individual product performance (as measured for minimum standards and energy labelling under products legislation). To analyse systems, building data are needed as the services demand from the building affects dimensioning and performance. Calculations are usually required and designers and installers need established procedures to follow, which are technology and site dependent, introducing complexity to the whole process.

At least 13 Member States have set minimum standards for the overall energy performance of TBS installed/retrofitted in existing buildings but only 5 have developed practical methods for this purpose. In addition, coverage of all technologies and their installation, dimensioning, adjustment, and control, is a significant challenge, even more important for combinations of systems (explicitly mentioned in the EPBD)[127]. This confirms the qualitative feedback provided by Member States and some respondents to the public consultation, raising that practical implementation was challenging. Regulations for TBS are not obligatory in new buildings. Nevertheless, at least 18 Member States apply TBS regulations to new as well as existing buildings, and in 12 cases the same regulations apply to both.

Under Article 8(2), the EPBD requires MSs to encourage the introduction of intelligent metering systems whenever a building is constructed or undergoes major renovation and to encourage, where appropriate, the installation of active control systems such as automation, control and monitoring systems that aim to save energy. Monitoring is not yet implemented by any Member State; there is low awareness of its potential. Concerns remain about privacy, security, safety and cost-effectiveness. There might be some scope for integration at technical level of interoperability and arrangements for data collection, transmission and display between different meters at building and/or system levels that could ease the practical implementation and enforcement of Article 8 on TBS throughout the EU.

The consultation of Member states, organised in the context of the Concerted Action, indicated that the mandatory setting of overall technical building system requirements in existing buildings is complex, difficult to define and expensive to enforce. The setting of overall technical building system requirements is generally considered as not economically justified by Member States.

Regarding operation of buildings, stakeholders pointed out that more could be done. Buildings managers and occupants have limited tools to optimise building performance during operation. Potentials remain untapped for benefiting from new technologies such as building automation, intelligent metering and maintenance of technical systems. Smart building energy management systems can produce savings for space heating in the range of 2-30% and for cooling 37-73% depending on the climate and building type. Services buildings consume most of Europe's space cooling[128]. Building operation needs to be improved through better benchmarking, using smart information technologies, sub-metering, real time information, and other innovative technologies.

The limited provisions of the EPBD aiming at incentivising the use of electronic monitoring and control of technical building systems, and more generally, the installation of building automation and control, had limited uptake so far. The EPBD

[127] Implementing the Energy Performance of Buildings Directives, 2015, Concerted Action EPBD

[128] An EU Strategy on Heating and Cooling, COM(2016) 51 final

include two provisions which could be considered to introduce building smartness in the landscape:

An encouragement to the installation of active control systems such as automation, control and monitoring systems that aim to save energy,

The possibility offered to Member States to reduce the frequency of regular inspections of heating and air-conditioning systems or lighten such inspections, as appropriate, where an electronic monitoring and control system is in place.

In this area, projects like iSERVcmb[129] demonstrated the potential benefits of electronic monitoring of energy efficiency of technical building systems. These potentials have been insufficiently used so far. No Member State made use of the possibility offered by the Directive to reduce the inspection frequency where electronic monitoring and control system is in place. At present, only one Member State is preparing regulations that will recognise monitoring as a partial substitute for inspection.

Moreover, a new European standard for smart appliances, SAREF (Smart Appliances REFerence ontology) was developed by the European Commission in close cooperation with industry and the European Telecommunication Standards Institute (ETSI) to create a new reference "language" for energy-related data[130]. This new language will be used by home devices, allowing them to exchange information with any energy management system. SAREF has the potential to enable the smart grid demand-response mechanism, to bring energy and cost savings, and to open new markets. To fully achieve these goals, efforts are already planned to align SAREF with existing standards for smart meters and external services, to fill in potential gaps and extend SAREF where needed.

The EPBD review represents an opportunity to better define the smartness concept, reinforce conditions applicable to BEMS, further promote building automation and use of website platforms and apps, and foresee the introduction of standards to ensure interoperability. These aspects require further analysis in the subsequent Impact Assessment phase.

The specific obligation to ensure that, before construction starts, the technical, environmental and economic feasibility of high-efficiency alternative systems is considered and taken into account was several times quoted as an example of unnecessary burden, in particular by Member States.

2.3. Efficiency in providing information through certification and inspection

The provisions on *EPCs* have proved to be effective in creating a demand-driven market for energy efficient buildings by providing information to building owners and tenants on the energy performance of their buildings, heating and air-conditioning systems, and on effective ways to improve these through building renovation works It was statistically established that the improvement in energy performance, as calculated, is associated with reduction in household energy expenditure[131]. In various recent

[129] http://www.iservcmb.info/

[130] https://ec.europa.eu/digital-agenda/en/blog/new-standard-smart-appliances-smart-home

[131] E.g. Household fuel expenditure and residential building energy efficiency rating in Ireland, 2015, Curtis J. & al.

studies[132], the EPC is seen as an effective tool with strong impact on sales and rental prices in the real estate market. The EPBD recast further reinforced this aspect by requiring the inclusion of the EPC indicator in advertisement and commercial media. Based on an analysis of residential markets in Europe, findings indicate that a better performing building resulted in up to 5-10% higher sale or rental prices per energy class on average[133].

Despite the fact that tenants and buyers are increasingly interested in their domestic energy bills with a significant influence on their choice of home, this positive effect is limited in certain Member States due to, importantly, the absence of accompanying measures, as well as a lack of trust and understanding in EPCs[134] in some Member States. Examples of effective accompanying measures[135] are linking cost-effective recommendations in EPCs to mortgage options or creating synergies between EPC schemes and financial support for building renovation. The lack of trust is in particular related to the discrepancy between the energy rating and actual energy consumption by owners/renters. Partly due to lack of understanding about the label among the public about what the rating means and partly lack of trust in the assessment method and quality of assessments and the fairness of the calculation methodology used. Member States are aware of these concerns and are addressing them in different ways for instance with focus on improving quality assurance of assessors and EPCs and quality control of EPCs via EPC databases.

At its introduction in 2002 EPCs were considered a pioneering instrument, one that would help overcome an information deficit hindering consumer interest in energy efficient buildings. At present, all EPCs include a recommendation section to provide tailor-made advice on how to improve the energy performance of buildings. After several years of implementation, the contribution of the EPC recommendations towards stimulating renovation is limited. The global economic context is certainly a limiting factor but some respondents to the public consultation challenge any causality between the recommendations that are provided in EPCs and action taken to upgrade the energy efficiency of buildings. This is backed-up by studies[136] bringing evidence that EPC recommendations had a weak influence, especially pre-purchase. While it is required by Article 11 that EPCs must include recommendations for the cost-optimal or cost-effective improvement of the energy performance of a building or building unit, and although most Member States have this in place in legislation, little evidence exist today of whether these recommendations actually lead to increased renovation rates as intended. This could be due to lack of requirements for reporting potential measures that has been done due to the recommendations, or it could be due to the absence of appropriate accompanying measures and limited trust in the certificates in some Member States, which leads to little attention being paid to the recommendations included in the certificates.

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132 For example: Institute for European Environmental Policy (IEEP); Directorate-General for Energy (DG Energy), 2013; The impact of Energy Performance Certificates on the rental and capital values of commercial property assets, 2011, F. Fuerst and P. McAllister

133 Energy performance certificates in buildings and their impact on transaction prices and rents in selected EU countries, 2013, Bio Intelligence Service

134 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

135 For example "The influence of the Energy Performance Certificate: the Dutch case", Energy Policy volume 67, April 2914, pages 664-672.

136 e.g. "The influence of the energy Performance Certificate: The Dutch case", 2014, Murphy L.

Finally, the provisions for the EPCs do not require an harmonised methodology for calculating the energy performance of buildings. As EPCs are not based on the same methodology, EPCs have not yet succeeded in supporting a comparable pan-European market for buildings energy efficiency investments[137], nor led to reduction of related transaction costs. The primary underlying reason is to be found in the lack of transparency of the national calculation methodologies that determine the energy rating that is included in the EPC (C class, for instance). When the methodology for calculating energy performance and the scaling and labelling differs from Member State to Member State, and sometimes from region to region, the same building placed in different Member States, e.g. two different sides of a national/regional border could differ in rating, with the same climate conditions. This is equally true for investments into non-residential buildings or for the bundling of smaller scales investments in the residential sector, which need underlying standards to rate the quality of the bundle based on the quality of its parts.

A similar picture can be drawn regarding the regular inspection of heating and air-conditioning systems. The essential purpose of inspection is to recommend improvements to energy performance that are cost-effective. When issued, inspection reports tend to be over-complicated and poorly suited to the needs of non-expert building owners; this means they are at greater risk of being ignored. Inspection reports are seen as duplicating the recommendation section of the EPCs where advice on building improvements is already being given. Though the opinion of the Member States is that the information produced for EPCs is not sufficiently detailed for heating and AC systems.[138].

Although reinforced by the EPBD, studies[139] show overall limited progress made as regards the independent quality control of EPCs and inspections. After surveying the Member States in March 2014, the Commission services observed that too small samples were randomly checked in most Member States to derive any conclusion on the quality of EPCs and inspection reports.

Certification is sometimes seen as an administrative burden, and there is limited willingness to pay higher prices for high quality EPCs and it is generally agreed that the reliability of EPCs must be significantly improved. In particular, concerns were expressed, although not fully grounded by evidence, with the quality and possible benefits of systematic recommendations, when compared to their costs[140]. Today EPCs for single family houses/apartment are typically sold for 85-140€[141], but lower prices below 50€ are also observed on the market. Such prices hardly leave the time to provide tailor made recommendation that could be trusted and taken up by building owners.

Targeted advice for households is considered effective in only 13 Member States[142]. Online calculators that act as a quick and simple way to work out how you could reduce your energy bills can use EPC data to propose concrete energy-efficiency solutions

137 Energy Efficiency Financial Institutions Group, "Energy Efficiency – the first fuel for the EU Economy. How to drive new finance for energy efficiency investments", February 2015, http://www.eefig.eu

138 Implementing the Energy Performance of Buildings Directives, 2016, Concerted Action EPBD

139 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

140 Public Consultation on the Evaluation of the EPBD – Final synthesis report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

141 http://www.viadiagnostic.fr/tarif-diagnostic-immobilier.html

142 Energy Efficiency Watch, 1015, Survey report - Summary and main conclusions

(sometimes referred to as called Home Energy Check) offer alternatives to systematic cheap recommendations[143].

More holistic approaches to EPCs implementation are already in application in some Member States and may reduce administrative burden, for example:

- The setting of minimum requirements according to EPC energy classes that enable the use of EPCs to ensure compliance and a monitoring of the building stock through a central EPC database,
- The involvement of other actors in the checking process (e.g. notaries for the hand over, of ECPs including for the rental agreement which practically ensures 100% compliance),
- Appropriate accompanying measures such as a more systematic link between EPCs and financial support, e.g. with an ex-ante and ex-post energy performance rating to set and check the appropriate level of financial support, or linking cost effective recommendations in EPCs to mortgage options.

Regarding inspection schemes, the EPBD left the possibility to opt for alternative measures to regular inspection schemes, to the condition that the alternative measures demonstrate equivalent energy saving impacts. In fact, 13 Member States opted for equivalent alternative measures to the regular inspections of heating systems and 7 for air-conditioning systems[144]. The justifications provided by the Member States that opted out of the regular inspection regime include high cost relative to benefits, the small number of individual boilers compared with district heating, and that regulations already ensure high standards beyond which there is little scope for improvement.

Other factors influencing the decision are that inspection is intrusive and unpopular, has doubtful benefits as there is no obligation to follow the recommendations in the inspection report, and the risk that it becomes simply a 'compliance exercise' with little value.

Energy performance certification of buildings on the other hand, is considered as a key policy instrument that can assist governments in reducing energy consumption in buildings[145], by increasing public awareness and stimulating the creation of a demand-driven market for energy efficiency in buildings.

However, energy performance certification of buildings should not be viewed as a goal in itself but as a key instrument to support and monitor the policy implementation and enforcement. Building rating programmes are considered to have greatest impact when integrated into a strategic and coordinated energy efficiency policy framework[146]. The relevance of such instrument is therefore conditioned to its better integration into the regulatory framework (link to minimum standards) and to broader initiatives designed to tackle multiple barriers (information campaigns and financial support).

There is an increasing number of best practices across Europe that demonstrate the added value of EPC data for policy making (e.g. to inform relevant renovation strategies) and monitoring, as well as market and research analysis. IEE project

143 Request to Action project IEE/13/789, www.buildings-request.eu, Best practice meeting

144 Implementing the Energy Performance of Buildings Directives, 2016, Concerted Action EPBD

145 IEA, 2010, Policy Pathways: Energy Performance Certification of Buildings

146 IPEEC, 2014, Building Energy rating schemes

EPISCOPE[147] has found that EPC's are an important data source but need to be cross-referenced with other data. If used in isolation data from EPCs often do not fully align with data/policy needs, are insufficiently accurate or not representative.

While it is not compulsory to set up a central/regional EPC register, almost all MS have advanced in setting up a system to collect EPC data. These measures were mostly taken in the context of monitoring and quality control of energy certification processes (required by the EPBD). In 2014, 24 countries had an operational central/regional EPC registers (plus Norway; Poland, Latvia, Luxemburg and the Czech Republic lining up to launch their own registries). In some countries (e.g. the United Kingdom and Belgium – Flanders), there are separate databases for residential and non-residential buildings. For Italy and Spain the databases are only available in selected regions. The standardised methodologies and formats of data collecting and sharing are still limited and should be promoted. EPC schemes are a tool that could be used for mapping and monitoring the national and European building stock and, if properly implemented, they could allow for the assessment of real market needs and the potential for energy efficiency improvements in the building sector[148].

Best practice from several EU member states, in particular Italy (Lombardy) Portugal, UK (Scotland), Ireland and the Netherlands has shown the potential of EPC databases when linked with other datasets and when opened up to wider circles of stakeholders. However, data protection and privacy issues need to be taken into account. [149]

Evidence derived from the public consultation shows that the recommendations section of EPCs is, in principle, also relevant in targeting renovations. However, simply providing tailor made recommendations to improve energy performance proved to be insufficient to trigger investments if EPCs are not embedded within an integrated policy framework that includes accompanying measures. In addition, the current low level of confidence in the instrument[150] limits the potential role that recommendations can play.

In multi-unit buildings, the association of energy rating with recommendation poses specific challenges. When subject to individual metering, the energy performance rating of single building units based on the average performance of the whole building provides inconsistent information to individual owners. This would be in favour of an energy performance individual rating. However, at the same time, recommendations targeting individual flats or building units would be in contradiction with the necessary agreement of the different owners. Such individual recommendations would render whole building retrofit based on EPC recommendations virtually impossible[151].

Therefore, policy options regarding energy performance rating and recommendations should explore new approaches to remove the barriers to full effect of EPCs and to the emergence of a market for renovation and subsequent transformation of the building stock.

147 See www.episcope.eu

148 EPCs across the EU, 2014, BPIE

149 Request to Action project IEE/13/789, European Best Practice meeting on EPC Databases, 04.11.14, Brussels

150 Energy Performance of Buildings Directive (EPBD) - Compliance Study, 2015, European Commission (written by ICF international)

151 LEAF Challenge project

2.4. Efficiency in relation to financial and fiscal incentives and information campaigns (EPBD Articles 10 and 20)

When looking at all the economic instruments for energy efficiency which were running in 2013, it is estimated that around € 9 billion were collectively spent on average by these programmes every year to support buildings renovation, which led to investments of around €24 billion. 90% of these funds were coming from national or regional budgets, while remaining sources were constituted of EU funds, revenues from selling Assigned Amount Units (AAU) Surplus, funds by International Financial Institutions and other sources. These funds were mainly channelled through governments and energy efficiency agencies. They were predominantly offered in the form of grants/subsidies, followed by loans and tax incentives[152].

According to the *ex-post* evaluation of Cohesion Policy Programmes 2007-2013, 129 national public financing mechanisms were identified to be in place between 2007 and 2013 in the EU 27 Member States to increase energy efficiency in buildings[153]. 90% of the European Regional Development Fund (ERDF) and the Cohesion Fund (CF) investments for energy efficiency, co-generation and energy management were provided in the form of non-repayable grants.

In general, there is some small progress in most Member States in terms of improving the focus, leverage and impact of informational and financial initiatives[154].

Although public funds allocations underpinning investments in building energy efficiency are steadily increasing (e.g. EUR 18 billion of European Structural and Investment Funds (ESIF) 2014-2020 allocated to energy efficiency investments, mainly in buildings), information on their effectiveness still remains limited both at EU and national levels.

An overview of value added tax (VAT) rates across the European Union indicates that several Member States apply reduced rates for social housing and for renovation of private dwellings[155]. One of the purposes of these reduced rates is to stimulate energy efficiency related investments in buildings and improve their affordability which could lead to increased renovation activity at national level and its depth. As regards the latter, the latest analysis of Member States' measures in support of the implementation of NZEBs[156] shows that several Member States have adopted tax incentives for energy renovations and taxation mechanisms as a tool to support building renovations towards deeper, NZEB levels.

The majority of energy efficiency measures in buildings are and should be funded by private finance, with public subsidies (both direct and indirect) acting as a lever and catalyst, not only to allocate scarce public resources where they are needed most but also to mobilize private capital allocation. In this respect, one of the delivery mechanisms (notably in public buildings sector and SMEs) based on private finance – funded investments paid off through savings is the Energy Performance Contracting

152 JRC report on Financing building energy renovations, 2014

153 A recent study mapping the current financial schemes for energy efficiency across the EU is under development.

154 Implementing the Energy Performance of Buildings Directives, 2016, Concerted Action EPBD

155 http://ec.europa.eu/taxation_customs/resources/documents/taxation/vat/how_vat_works/rates/vat_rates_en.pdf

156 JRC synthesis report on national plans for NZEB, 2016

(EnPC) [157]. However, despite its potential[158] and solid business case, the EnPC market is still underdeveloped in the EU (compared for example to the US market[159]).

The EPBD's impact on the EnPC market growth has so far been limited, mostly due to the fact that the track record (data) on energy efficiency investments' impacts in buildings has not been robustly established, which in turn prevented building operators and Energy Service Companies from realising the full investment potential related to the reduction of operational costs. Another stumbling block for EnPC investments growth in the public sector that go beyond the EPBD provisions are the EU Stability and Growth Pact and related provisions (ESA 2010, MGDD). According to these provisions, EnPC investments are required mostly to be consolidated on the balance sheet of public sector entities (unless constructed as PPPs), increasing public debt/deficit. In turn, many energy efficiency investments planned in the public sector are either not realised, or decided to be funded through subsidies (that have no implications on debt/deficit) which, as a consequence, limits the scope for EnPCs going forward in the EU.

A number of IEE and Horizon 2020 projects support the development of the EnPC market, by improving confidence in EnPC[160], developing EnPC facilitation services[161], or training EnPC contractors to develop new service offers[162]. Concrete implementation of EnPC is also addressed by several Project Development Assistance (PDA) projects[163], funded under IEE and H2020, with a focus on public buildings[164], including the aggregation of small investments by municipal authorities[165], as well as on multifamily buildings[166] and social housing[167].

A number of other financing and delivery mechanisms for building energy renovation are being developed and implemented throughout the EU[168]. They include the development of integrated services or operators for building renovation on public buildings[169] or deep renovation of private housing[170].

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157 Energy Performance Contracting (EPC) is a form of 'creative innovative financing' for capital energy retrofitting improvement which allows funding energy upgrades from cost reductions by providing a guarantee on energy savings; upfront investments may be financed by the contractor or by the building owner.

158 The European ESCO Market Report 2013, 2014, European Commission DG JRC

159 In the USA, the volume of investments through Energy Performance Contracting transactions reached around USD 7.9 billion since 1999 and is expected to grow to around USD 11-15 billion by 2020.

160 Transparense and Trust EPC South projects

161 Transparense, EESI2020, Streetlight EPC, EnPC Intrans, GuarantEE projects

162 EPC PLUS project

163 http://ec.europa.eu/energy/intelligent/getting-funds/project-development-assistance/

164 MLEI BEAM GRAZ (AT) project

165 MLEI 2020TOGETHER (IT), FESTA (IT), MLEI GLEE AM (PT), MLEI MARTE (IT), MLEI ENSAMB (NO)

166 MLEI POSIT'IF (FR), SUNSHINE (LV) projects

167 ENERSHIFT (IT), LEMON (IT) projects

168 An analysis can be found in 'Increasing capacities in Cities for innovating financing in energy efficiency. A review of local authority innovative large scale retrofit financing and operational models', CITYnvest project, 2015, http://www.citynvest.eu/sites/default/files/library-documents/20151202_WP2%20Final%20Report-V1.3.pdf. The CITYnvest project assesses innovative financing models, introduces them in a tailored way in 3 pilot regions and conducts corresponding capacity building in 10 focus countries.

169 MLEI ESCOLIMBURG2020 (BE) project

170 MLEI POSIT'IF (FR), MLEI PSEE Alsace (FR), ELENA Picardie (FR)

The strong economic narrative for MFF 2014-2020, also supported by the Investment plan for Europe, calls for innovative approaches when allocating public funds through wider use of appropriate financial instruments[171]. Some progress has been achieved (e.g. European Energy Efficiency Fund and Private Finance for Energy Efficiency Initiative at the EU level and the JESSICA II Fund in Lithuania are explicitly targeting energy efficiency investments in buildings), but the energy efficiency investments market needs to evolve, mature and grow further. Large scale renovation of buildings across Europe requires (at the *finance supply side*) standardisation[172], simplification, transparency, right combination of public/private funds and development and roll-out of attractive financing products (e.g. green mortgages). On the *finance demand side*, long-term regulatory stability and clarity, demand creation and full understanding of related benefits are key drivers that need to be addressed.

The regulatory framework and financial architecture (i.e. ways of using public money) have to be mutually supportive, and address important barriers that still hamper further uptake of energy efficiency investments in buildings, including:

- Lack of awareness and expertise regarding structuring investible projects on the part of all actors, in particular public authorities[173];
- Fragmented and isolated small-scale investments driving up transaction costs;
- High initial capital expenditure, with relatively long pay-back periods;
- (Perceived) high credit risk mostly stemming from missing (financial performance) track record due to weak monitoring and reporting of impacts, and leading to an asset-based lending (mortgages, corporate debt) rather than non-recourse lending (featuring-in the increase in asset value or cash flows generated by savings) ; and
- Competing investment priorities of final beneficiaries[174].

To address this diagnosis, the Energy Efficiency Financial Institutions Group provided six recommendations to policy makers[175]:

- Ensure the effective transposition and enforcement regarding the energy performance of buildings (including their performance certification),
- Deliver regulatory stability for energy efficiency investments in buildings,
- Address the need for high quality buildings performance data and standards.
- Initiate a review and benchmarking process to better understand the decision making frameworks for public buildings,
- Benchmark and compare the relative successes of retail residential energy efficiency investment programmes in the Member States,

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171 Cf. Infinite Solutions project, developing financial instruments for renovation of housing and internal performance contracting in 9 cities in Europe; CITYNVEST project

172 Under Horizon 2020, the Investor Confidence Project Europe (ICPEU) is developing standard protocols to facilitate the due diligence process for financiers; on this basis, the SEAF project is developing an integrated project valuation and risk assessment/mitigation platform which will facilitate, inter alia, the match-making between project developers and investors.

173 For example, IEE project CERtuS identifies barriers to financing of renovation projects in four Mediterranean municipalities. See www.certus-project.eu

174 Communication COM(2013)225 final of 18 April 2013 reporting on Financial support for energy efficiency in buildings

175 Energy Efficiency – the first fuel for the EU Economy: How to drive new finance for energy efficiency investments, 2015, Energy Efficiency Financial Institutions Group (EEFIG)

- Ensure that Member States adequately identify the funding streams for their National Buildings Renovation Strategies (Article 4 of the EED).

A number of EU-funded projects gave examples about how to overcome such non-technical barriers. In northern European countries, the project Total Concept is proposing to owners of non-residential buildings a package of energy efficiency measures when they plan to renovate their assets. The package is tailor-made not only to the building and to the needs of the users, but also in line with the profitability expectations of the investor. By packaging the measures, deeper energy cuts and higher return on investment can be reached[176]. In warm, Mediterranean countries, the project RepublicZEB has developed a definition of passive houses in warm climates. It has enabled participating public authorities to learn from best-practice is similar European regions[177]. The LEAF project works with multi-owner apartment blocks on overcoming challenges of decision-making in divided ownership[178]. The Powerhouse NZC has boosted knowledge, monitoring and implementation of NZEB in social housing across Europe[179]. All projects have confirmed the importance of seizing windows of opportunity, in particular moments when deep renovations are anyways planned and/or when financing becomes available.

The recently adopted EU Strategy on Heating and Cooling indicated that, under the Smart Financing for Smart Buildings initiative, the Commission will:

- Facilitate the aggregation of small projects into investible packages, and, with EEFIG, test a framework for underwriting procedures for financial institutions to incorporate energy efficiency in everyday market practice;
- Encourage Member States to establish one stop shops for low-carbon investments (encompassing advisory services, Project Development Assistance and project financing); and
- Encourage retail banks to offer products adapted for renovation of privately rented buildings (e.g. deferred mortgages, term loans) and disseminate best practices, also in relation to tax treatment of renovation.

It has been estimated that public support for building renovation investment frequently yield a net financial gain to the State, around €5 back to public finances for €1 invested by government in renovations[180].

However, a significant weakness is that monitoring of results and effectiveness of policies and programmes remains underdeveloped in most Member States[181]. Incorporating the need for both *ex-ante* evidence base and *ex-post* monitoring into policy and programme planning will help identify data needs and collection approaches, and there is scope for standardised performance data collection and evaluation systems to minimise administration and transaction costs[182] for financiers and users. *Ex-ante*

176 Total Concept, IEE/13/613, www.totalconcept.info

177 RepublicZEB, IEE/13/886, www.republiczeb.org

178 LEAF, IEE/12/658, www.lowenergyapartments.eu

179 PowerhouseNZC, IEE/11/007, www.powerhouseeurope.eu

180 Horizon 2020 projects COMBI and IN-BEE, Renovate Europe Campaign and KfW energy efficiency programmes in Germany

181 Study " Lead market initiative - assessing the impact of national recovery measures on construction in the EU-27"

182 Implementing the Energy Performance of Buildings Directives, 2016, Concerted Action EPBD

assessments are essential when developing energy efficiency financing schemes as different market segments require different approaches. Financial products need to be customised and adapted to local conditions in order to be successful. They need to take into account the characteristics of local businesses, organisational behaviour patterns, legal framework as well as the availability of technical capacities to develop good investment projects which could be attractive to both project owners and financers.

A major challenge remains to accelerate building renovation rates in both the residential and non-residential sector, especially deep renovations where possible and relevant. The need for increased private investments and related (appropriate and attractive) financing products, as well as the need to motivate building owners/tenants to invest are still relevant. Barriers to renovations are particularly difficult to overcome for low-income households and vulnerable consumers, or in situations where energy efficiency measures do not match the lifecycle of the building (e.g. when partial renovation has been implemented recently).

With the right set of policy tools, it is generally excepted that governments will play a crucial role in promoting energy efficiency and leveraging more investments in the building sector, especially in the existing stock, where (as experience shows) investment opportunities are insufficiently understood and seized. For now, public support schemes appear to dominate the policy framework for existing buildings, as they are particularly important for tackling risks associated with lengthy payback periods and activating the market for energy renovations. At the same time, the need for more market action and enhanced private sector involvement is increasingly recognised as this offers the only sustainable route for scaling up existing efforts[183].

Experience so far in the context of Cohesion Policy funding in the 2014-2020 period shows that synergies between financial incentives and compliance with EU obligations on energy efficiency in buildings need to be maximised[184] to deliver the required upfront investments. The introduction of so-called *ex-ante* conditionalities linking financial support for building renovation and compliance with Articles 3, 4, 5 and 11 of the EPBD (minimum energy performance requirements and Energy Performance Certification) have proven to be effective at driving implementation of the key provisions of the EPBD.

Under the Article 4 of the Energy Efficiency Directive, Member States have developed long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. 74 % of the submitted strategies satisfactorily address the main elements of the Energy Efficiency Directive[185]. Taking into consideration that these were the first renovation strategy documents submitted by the Member States, the quality and the actual implementation of the strategies are expected to improve further in the future. In this respect, to ensure long-term consistency, it will be important that the Strategies include also a solid investment/financing plan including the identification of funding sources, financing mechanisms, their complementarities and, most important of all, solid analysis over achieved and further expected impacts.

183 Final report on financing EE in buildings, 2014, European Commission (DG JRC)

184 Technical guidance "Financing the energy renovation of buildings with Cohesion Policy funding, European Commission, 2014

185 Synthesis Report on the assessment of Member States' building renovation strategies, 2015, JRC.

3. Conclusion

The choice of a cost-optimal benchmarking methodology to steer existing national energy performance requirements towards cost-efficient levels has proved to be an efficient and results-oriented approach. The cost-optimal calculations allowed the identification of cases where there is still a significant potential for cost-effective energy savings. The analysis of the first cost-optimal calculations showed that some Member States took the political decision of setting minimum requirements above the cost-optimal levels, possibly because of the non-economic benefits of improved building energy performance, which are not integrated in the framework calculation methodology.

The NZEB targets have been found coherent with the principles of cost-optimality and cost-efficiency. The evidence suggests that existing technologies related to energy savings, energy efficiency and renewable energies are sufficient to reach, in combination, a suitable target for nearly zero-energy buildings. A technology gap that would need to be bridged by 2021 has not been identified. Analysis of the cost-optimal reports required under Article 5 of the EPBD indicates that a smooth transition between cost optimality and NZEB is achievable. No Member State has yet reported any legislative regime for not applying the NZEB requirements in specific and justifiable cases, as permitted under Article 9(6) of the EPBD. This non-use of the exception permitted implies that Member States do not find the NZEB concept and targets problematic.

It can be questioned whether the requirement to establish national EPC schemes, which has resulted in different layouts for labels and recommendations across Member States and regions, is efficient. EPCs have a different layout and content in different EU Member States, though most countries have implemented an A-G scheme similar to the EU energy labelling for energy using products. Even when label layouts are similar, the rating of the building cannot be compared across Member States as based on a different energy performance calculation methodology. For the user or citizen, a comparable layout could be potentially more misleading given that the underlying calculation differs. However, there is a case for better comparability across Member States to drive investments in the most energy efficient buildings. This is demanded in particular by market participants in the non-residential sector, which are often multinational property owners and development companies. This need is being tackled through a voluntary common European Union certification scheme for the energy performance of non-residential buildings, currently under development as part of the implementation of Article 11(9) of the EPBD. This scheme will be based on CEN standards for calculating the energy performance of buildings, presently under finalisation. This common scheme will allow for the fair comparison of different buildings' energy use across borders.

In general, the additional administrative and regulatory processes created by the EPBD are considered necessary by most of the respondents to the public consultation, in the light of the energy saving potential in the buildings sector.

The national implementation of the Directive could be more efficient in several cases. For example, half of the Member States have a different calculation method for setting and ensuring minimum energy requirements, on the one hand, and for certifying buildings on the other hand.

Such implementation choices create complexity and limit the readability of the policy for end users. For the comparison, it could be compared to a framework related to manufactured products where Ecodesign and Energy Labelling would have two different measurement standards.

More holistic ways to implement the Directive generally would result in a reduction of the administrative burden and give more clarity to the overall system.

Efficient mechanisms to effectively enforce the legislation have not always been found at national level, especially elements related to renovation.

The EPBD offers a certain guarantee of efficiency by indicating that Member State are not required to set minimum energy performance requirements which are not cost-effective over the estimated economic lifecycle. This adds to the setting of minimum requirements at cost-optimal level, which prevent from overly ambitious minimum requirements that the market would not able to cost-effectively deliver. Such overambitious requirements could have a negative impact on the activity.

The efficiency of a few specific components is questioned by several Member States. This concerns in particular requirements for inspections of heating and cooling systems and the technical, economic and environmental assessment of alternative heating and cooling systems, including decentralised or district solutions, preceding the construction of new buildings.

Annex 11 EVALUATION OF THE RELEVANCE

The European building stock is responsible for 30% of the EU greenhouse emissions[186] and approximately 40% of the final energy consumption[187]. The building stock is expanding in size and its energy consumption and CO_2 emissions are bound to increase in absence of tighter energy performance minimum requirements. Hence, addressing the energy performance of buildings remains relevant to address the 2020-2030-2050 energy and climate policy objectives and boost energy security.

1. EU energy and climate targets

Most of the saving potential lays within the EPBD scope (space and water heating, space cooling, ventilation and their auxiliary, and lighting in the non-residential sector). Remaining cost-effective saving potential of 33 to 80.5 Mtoe are estimated by 2030[188].

The mechanisms of the EPBD remain relevant:

- The choice of a cost-optimal benchmarking methodology to steer existing national energy performance requirements towards cost-efficient levels is recognised to be an efficient and results-oriented approach. The continuation of this mechanism of periodic review of minimum levels of energy performance requirements based on cost-optimality will effectively maintain a level playing field across Europe;
- The influence on property valuation confirms that the energy performance, as an asset rating, can provide an accurate real estate market signal by reflecting the characteristics of the building in typical use conditions, independently from behaviour of former and prospective occupiers[189]. As integrated metric, energy performance leaves sufficient flexibility to the construction industry to design and build new buildings and renovation programs in the most cost-effective way within the local conditions of each specific project.

The transposition of the EPBD into ambitious building codes in the Member States is and will continue to help Member States to reach their GHG reduction targets for the non-ETS sector under the Effort Sharing Decision (ESD)[190]. The ESD covers mainly GHG emissions in the transport, buildings, agriculture, small industry and waste sectors. These sectors accounted for more than 55% of total EU GHG emissions in 2013. The ESD does not set specific emission targets for these individual sectors covered by it, but leaves it to Member States to choose where to achieve the necessary reductions. According to recent estimates, the building sector is expected to have an above average (above current trends) contribution to continued emissions reductions post 2020, mainly thanks to the continued impact of energy efficiency improvements[191].

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186 GHG emissions in the overall inland GHG emissions for Commercial/Institutional/Residential sectors (without LULUCF and without international aviation and international maritime transport). Source: Eurostat.

187 Calculation made by aggregating annual final energy consumption data from Eurostat.

188 Calculation based on the Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy efficiency/saving potential until 2020 and beyond, 2014, Fraunhofer ISI.

189 e.g. IEE project RenoValue is developing a training toolkit on building energy performance for property valuation professionals, building upon EPCs in particular. See http://renovalue.eu/

190 Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020

191 Impact Assessment accompanying the document Proposal for a Regulation on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 for a resilient Energy Union and to meet

2. Other benefits

Better energy performance of buildings can deliver social co-benefits as a result of enhanced usability of the building, more efficient use of resources, enhanced health and quality of life, stimulating economic recovery and promoting growth and the creation and retention of jobs[192].

2.1. Economic benefits

In macro-economic terms the construction industry and in particular the building industry is very important to the EU economy. The construction sector provides 20 million direct jobs, mainly in SME's, and contributes to about 10 % of the EU's GDP. In 2014, the total Construction sector output was €1,211 billion, €961 billion on buildings[193].

The JRC-LUISA modelling platform and the ESPON TIA Quick Scan tool were used to carry out a pilot Territorial Impact Assessment (TIA) on the Energy Performance of Buildings Directive[194]. Preliminary results in using the ESPON TIA Quick Scan tool suggest positive territorial impact of the EPBD in particular on employment in the construction sector: 16% of metropolitan regions might experience a very high and 79% a high positive impact on employment in the construction sector.

2.2. Health and indoor environment

The Directive 2002/91/EC and EPBD requires energy performance to take indoor climate into account but leaves to EU Member States the way to regulate and ensure that the improvement of the energy performance of buildings adequately takes into account and efficiently implement indoor environment quality (i.e. indoor air quality, thermal comfort, noise and lighting) and ventilation requirements at national level. However, gaps in the national regulatory framework can be observed today[195], in particular for existing buildings where health-based mandatory minimum IEQ requirements can hardly be found in national/regional building codes.

It is essential that meeting minimum energy performance requirements and achieving the required level of indoor environmental quality (IEQ) [196] receive the same level of attention and are mutually and consistently reinforced in plans and actions of EU Member States for renovating the European building stock. Without such precaution and clear implementing provisions, current trends towards more airtight and less glazed building envelopes could further deteriorate the indoor environmental quality of buildings in EU and consequently the comfort and health conditions of the buildings' occupants.

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commitments under the Paris Agreement and amending Regulation No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and other information relevant to climate change SWD(2016) 0247 final of 20 July 2016

192 Multiple benefits of EE renovations in buildings, 2012, Copenhagen Economics

193 Source: FIEC

194 Pilot Test on the Territorial Impact Assessment of the Energy Performance of Buildings Directive, 2016, European Commission

195 "Promoting healthy and energy efficient buildings in the European Union: National implementation of related requirements of the Energy Performance Buildings Directive (2010/31/EU)", 2016, European Commission's JRC report (EUR 27665 EN)

196 Indoor Air Quality Thermal Comfort Daylight, 2015, BPIE

Buildings play an important role on EU citizen's living and health conditions. People spend 60-90% of their life in indoor environments (homes, offices, schools, etc.). In 2012, 99,000 deaths in Europe were attributable to household indoor air pollution[197]. 2.2 million estimated DALYs (Disability Adjusted Life Years) are lost each year in Europe due to exposures to pollutants in buildings[198].

The burden of cold temperatures can be measured through the number of Excess Winter Deaths (EWD). There is strong evidence that cold housing is largely responsible for excess winter mortality: the literature shows that between 30% and 50% of excess winter mortality is attributable to housing. Given that in Europe, there are about 250,000 excess winter deaths each year, it can be estimated that 50,000 to 85,000 excess winter deaths are attributable to cold housing in the EU[199].

2.3. Energy poverty

Buildings have also a big influence on EU citizen's and households' economic conditions. In 2012, 11.2 % of the EU-28 population lived in households that spent more than 40 % of their disposable income on housing. In Greece, Denmark, Germany, Romania, Bulgaria, the Netherlands and Spain this rate exceeded 14.0 % while the lowest rates were reported by Cyprus (3.3 %) and Malta (2.6 %)[200]. In 2010, it is estimated that around 20% of EU-28 households' expenditures for housing were for electricity, gas and other fuels[201].

Energy efficiency measures in buildings are one of the means to address high-energy expenditure in households, which, together with low income, is one of the indicators used to identify households in risk of energy poverty. For example many Member States have been implementing programs to support measures to improve the energy performance of low-income homes and, thereby, address energy poverty. However, such energy poverty schemes mostly remain stand-alone instruments and are not integrated in a broader strategy on national or even on EU level[202]. Some Member States[203] are using EPCs as a proxy for high-energy expenditure and a tool to target national policies with a social aim.

Improving Energy performance of the building stock supports the achievement of the EU energy and climate targets and contributes more broadly to an efficient use of resources, stimulating economic recovery and promoting growth and creation and retention of jobs. Interventions in buildings must be seen more globally as an opportunity to improve indoor environment and living conditions, including in relation to energy poverty. Low energy efficiency is one of the main causes of energy poverty. Energy efficiency measures, particularly those focusing on building retrofits, are a key part of strategies to address energy poverty[204].

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197 Burden of disease from Indoor Air Pollution for 2012, 2014, World Health Organisation

198 Promoting actions for healthy indoor air (IAIAQ). European Commission's Directorate General for Health and Consumers. Luxembourg, 2011

199 Environmental burden of disease associated with inadequate housing, 2011, World Health Organization

200 SILC-Survey, 2013, Eurostat

201 Household Budget Survey, 2010, Eurostat

202 Alleviating Fuel Poverty in the EU, 2014, BPIE

203 Developing the regulation of energy efficiency of private sector housing - Modelling improvements to the target stock, 2015, Scottish government

204 Energy poverty and vulnerable consumers in the energy sector across the EU: analysis of policies and measures, INSIGHT-E, May 2015

2.4. The building renovation challenge:

The quality of the supplied energy is already considered in through the conversion to primary energy. The district-scale is an attractive option due to the potential high upscaling factor of any intervention. Transformation of the energy supplied to buildings can improve the energy performance of several buildings.

However, the workshop organized by EASME on this topic (Cf. also Annex 4) highlighted that challenges and barriers are aggravated when scaling up from building to district.

There is space for the consideration of energy in the urban planning. The need for district-scale planning is certainly higher for the integration of renewable energy sources than it is to work on the energy efficiency of buildings.

No strong argument to change the current boundary conditions of the EPBD could be found.

3. Areas of improvement

There are however three aspects where the stakeholder consultation reveals that the EPBD is not yet fully delivering on the identified needs:

- ensuring a closer link between the energy performance of buildings. Disclosure and accessibility of performance data by third parties (such as ESCOs and Financial Institutions) is an important driver for reaching market maturity, necessary for scaling up private investment. Different stakeholder groups require information that makes sense to them and that can support informed decisions and the actual energy consumption appear to be one of the information necessary to establish more strongly the business case of energy renovation, especially in a context where gaps are reported between the estimated savings at design stage and actual savings after renovation . Synergies could therefore be reinforced with additional information on actual energy consumption Technical progress on better ICT can play an important role, e.g. through the use of central databases to collect information and redistribute statistical data .
- making more explicit that cost-effective energy performance upgrades requires both energy efficiency and renewable energy measures;
- taking better advantage of the technological progress for the decarbonisation of the economy by creating a stronger link between building codes and ‘smartness’ of technical building systems, e.g. ability to provide information on operational energy consumption to the consumer; to adjust to the needs of the user; to run the efficient and comfortable operation of the building; to connect to electric vehicle charging, to host energy storage and to support demand response.

Options to address these three aspects should be analysed in the Impact Assessment.

Annex 12 EVALUATION OF THE COHERENCE

No internal contradiction was found within the EPBD, nor with other EU-Policies at this point in time. Important complementarities within the EPBD and between the EPBD and other pieces of legislation exist and should be further exploited, in particular in the national implementation frameworks.

1. Internal coherence

No internal contradiction could be identified during the evaluation. The provisions related to the setting of minimum requirements for new and existing buildings, the provisions for EPCs and inspections, and on more general measures to address market barriers, are focusing on different and complementary aspects. These provisions support each other and, as established in Annex 10 analysing the efficiency, can benefit better of this complementarity.

2. External coherence

2.1. Coherence with other legislation promoting energy efficient buildings

The objective of the EPBD to support the increase of building renovation depth and rates is supported by other EU legislation; *inter alia*, the EED and by the European Structural Investment Funds (ESIF).

The ESIF framework and EED building-related provisions aim at providing and/or optimising financial support for the renovation of the building stock and triggering increased renovation rates. There is room to improve their implementation, which implies aligning the renovation depth with the minimum quality standards provided by the EPBD and the monitoring of effectiveness of financial support with the operational benefits that EPCs can provide.

The long term renovation strategies bring together different elements of the EED and of the EPBD. More specifically, Article 9(2) of the EPBD aims at increasing renovation depths by setting national support policies to refurbish existing buildings to deeper, NZEB levels. The obligation in Article 9(2) of the EPBD is complemented by national long term building strategies under Article 4 the EED, which should result in increased renovation rates through mobilising finance and investments in building renovation.

The assessment of the national long-term renovation strategies developed under Article 4 of the EED[205] revealed that in most cases Member States merely reported a reference to the cost-optimal methodologies but did not integrate the results within the strategy. The use of national EPC databases to link EPCs with financing schemes and contribute to better enforcement of building provisions was generally lacking. Further, disclosure and accessibility of performance data by third parties (such as ESCOs and Financial Institutions) is an important driver for reaching market maturity, necessary for scaling up private investment.

Articles 5 and 6 of the EED establish, respectively, renovation targets for central government buildings and purchasing by public bodies of high energy efficiency performing products, services and buildings. These EED articles work in synergy with

[205] Synthesis Report on the assessment of Member States' building renovation strategies, 2015, European Commission (JRC)

the provisions of the EPBD: whilst articles 5 and 6 of the EED stimulate the renovation rate and the demand for highly energy efficient buildings in public bodies, the provisions of the EPBD ensure the necessary quality of results (i.e. to meet at least the minimum energy performance requirements).

Finally, Article 7 of the EED on energy saving obligation schemes (and alternative policy measures) has indirect links to buildings. Energy saving obligations schemes are one of the tools for financing energy efficiency measures in building. Though the involvement of energy distributors or retail companies, these schemes have proved to be in practice an effective means to aggregate small scale investments, stimulating higher renovation rates. Of the alternative measures used by Member States to achieve the energy savings required under Article 7 of the EED, 42% are building related.

2.2. Coherence with the legislation related to energy efficient products

The obligations arising from the EPBD to set and ensure minimum energy performance requirements for building elements, on the one hand, and the EU legislation on ecodesign and energy labelling energy efficiency of products, on the other hand, were found coherent.

Building elements generally consist of several products. For example, a wall (building element) generally consists of several layers of material with various insulation properties and technical building system generally consists of generation, distribution, emission and control sub-systems, involving themselves several products.

The energy performance of an integrated building element is more than the sum of the energy performance of the individual products involved, although of course those products must respect the applicable EU ecodesign and/or energy labelling legislation. Proper design and installation, taking into account internal and external systemic interactions, have a big influence on the resulting performance of a building element.

Energy efficient building products can support, without guarantee of results, the achievement of better energy performing building elements. For instance, an efficient boiler can help to get an efficient heating system (composed of a source of warmed air, a means of distributing the air to the rooms being heated (e.g. pipes), and a control used to regulate the system (e.g., thermostat)).

Rather than a matter of coherence, the question is whether it is effective and proportionate to, at the same time, set minimum requirements on the energy efficiency of building-related products under ecodesign, and the energy performance of installed, retrofitted or replaced building elements under building codes. This is assessed on a case-by-case basis during the process of developing specific ecodesign and/or energy labelling implementing measures, having in mind the requirements of the EPBD: for example it was decided not to set ecodesign requirements for thermal insulation given that they are well covered under national implementation of the EPBD. In terms of building related products, at present ecodesign and energy labelling requirements only apply to boilers, air conditioning and air heating products.

2.3. Coherence with the legislation on the promotion of the use of energy from renewable sources

By looking at the integrated energy performance of buildings and considering, in addition to the quality of insulation of the building, heating installations, cooling installations, energy for ventilation, lighting installations, position and orientation of the building, heat recovery, active solar gains and other renewable energy sources, the EPBD goes beyond energy efficiency and considers the positive influence of renewable energy sources requiring e.g. that the national/regional calculation methodologies for the energy performance of building consider the positive influence of active solar systems and other heating and electricity systems based on energy from renewable sources, cogeneration or district heating and cooling, consistently with the Directive on the promotion of renewable energy sources[206].

The provisions of the EPBD naturally drive the use of renewable energy sources, as the calculation of the integrated energy performance should take into account the positive influence of active solar systems and other heating and electricity systems based on energy from renewable sources, cogeneration and district heating and cooling, consistently with relevant Union legislation, including Directive 2009/28/EC.

The tightening of energy performance requirements results in an increased cost-effective use of systems based on energy from renewable sources[207]. Nearly zero-energy buildings will significantly involve the use of energy from renewable sources, although not through a one-fits-all cost-effective solution.

At the same time, under the Directive on the promotion of renewable energy sources, in particular Article 13(4), Member States have to, in their building regulations and codes (or by other means with equivalent effect and where appropriate), require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation. Member States must permit those minimum levels to be fulfilled, inter alia, through district heating and cooling produced using a significant proportion of renewable energy sources. These measures are complementary to the NZEB requirements in the EPBD.

2.4. Coherence with other initiatives

In macro-economic terms the construction industry and in particular the building industry is very important to the EU economy. The construction sector provides 20 million direct jobs, mainly in SME's, and contributes to about 10 % of the EU's GDP.

Increasing building renovation depth and rates including as a result of the implementation of the EPBD contributes to the sustainability and competitiveness of the construction sector, e.g. by improving environmental performance and creating business opportunities in line with the Strategy for the sustainable competitiveness of the construction sector and its enterprises[208]. The energy performance of buildings

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206 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

207 Towards nearly zero-energy buildings- Definition on common principles under the EPBD (http://ec.europa.eu/energy/sites/ener/files/documents/nzeb_full_report.pdf), carried out by Ecofys for the European Commission, DG ENERGY.

208 Communication COM(2012)433 final of 31 July 2012 on a Strategy for the sustainable competitiveness of the construction sector and its enterprises

during their operation is only one element of the much broader environmental performance of a building over its life-cycle. The construction and use of buildings in the EU account for about half of all our extracted materials 40% of energy consumption and about a third of our water consumption. The sector also generates about one third of all waste and is associated with environmental pressures that arise at different stages of a building's life-cycle including the manufacturing of construction products, building construction, use, renovation and the management of building waste. Recycling these materials, as opposed to ending up in landfills, is crucial to the circular economy. These manufacturing, recycling and end-of life aspects are outside the scope of the EPBD.

The Communication on resource efficiency opportunities in the building sector[209] identifies other possible negative impacts that could be better taken into account, and paves the way to more global approaches to consider environmental impacts throughout a building's life cycle. This includes taking into account of both embodied and operational energy during the life cycle of a building. This total energy should be the focus, as a highly energy efficient building may come at a high cost of embodied energy. Similarly, this Communication as well as the recent EU Action Plan for the Circular Economy[210] stresses the importance of recycling of construction and demolition waste, already laid down in the Waste Framework Directive. This waste stream makes up about a third of EU total generated waste. To enable recycling, selective demolition where materials are easily separated at the end of life stage is imperative. This in turn requires considerations at the construction and renovation stages, with suitable materials being put together for easy disassembly. Failure to do so is likely to result in increased land filling of construction and demolition waste. Existing experience indicates that this is particularly critical during renovation.

Buildings have also a big influence on EU citizen's economic conditions. In 2012, 11.2 % of the EU-28 population lived in households that spent more than 40 % of their disposable income on housing. In Greece, Denmark, Germany, Romania, Bulgaria, the Netherlands and Spain this rate exceeded 14.0 % while the lowest rates were reported by Cyprus (3.3 %) and Malta (2.6 %)[211]. In 2010, it is estimated that around 20% of EU-28 households' expenditures for housing were for electricity, gas and other fuels[212]. The EPBD, in its recital 20, indicates the reduction of energy poverty as a potential benefit that could be achieved by the reduction of existing legal and market barriers and the encouragement of investments and/or other activities to increase the energy efficiency of new and existing buildings.

Studies have identified social and other co-benefits of energy efficiency measures in buildings, with links to policies having a social aim. Several Member States are implementing programs to support measures to improve the energy performance of low-income homes and, thereby, address energy poverty. However, such energy poverty schemes mostly remain stand-alone instruments and are not integrated in a broader strategy on national or even on EU level[213].

The Commission is currently evaluating the Construction Products Regulation (EU no. 305/2011) and is preparing a fitness check of relevant EU legislation impacting,

[209] Communication COM(2014)445 of 1 July 2014 on resource efficiency opportunities in the building sector

[210] Communication COM(2015)0614 final on Closing the loop – An EU Action Plan for the Circular Economy

[211] SILC-Survey, 2013, Eurostat

[212] Household Budget Survey, 2010, Eurostat

[213] Alleviating Fuel Poverty in the EU, 2014, BPIE

positively and negatively, the construction sector. This fitness check will assess legislation covering internal market, energy, environment, and health and safety aspects in terms of its impact on the competitiveness and sustainability of the construction sector.

Under the Digital Agenda targets (namely all Europeans have by 2020 internet speeds above 30 Mbps), Directive 2014/61/EU[214] aims at laying down some minimum rights and obligations, applicable across the Union, to bring the high speed communication infrastructure closer to the end-user's location. The limited provisions of the EPBD aiming at incentivising the use of electronic monitoring and control of technical building systems, and more generally the installation of building automation and control, had limited uptake so far. ICT (Information and Communication Technologies) are expected to play a major enabling role in the future of buildings. Based on sensors, controls, real time data and cloud based solutions, ICT can provide self-learning control systems optimising building operation, allowing for reliable energy signatures and generating automated proposals for energy savings. The ICT solutions rightly integrated into building stock would bring the much needed transparency into the building day-to-day operation and ease the occupant access to his/her own assets and build-on credibility in savings from buildings, thus facilitating the management of buildings also from an energy perspective. This – combined with much developed today power analytics capacities based on Big Data – should help customers find ways to reduce energy usage in a comprehensive and highly effective manner. In this regard, the EPBD and Directive 2014/61/EU can be mutually supportive by creating respectively the demand and the offer for high-speed electronic communication networks.

Solutions at district and city level function as a multiplier of improvements of energy performance in individual buildings, may facilitate integration of renewable energy, and aggregation of demand response, as well as energy efficiency solutions, and can help attracting investments into energy efficiency and renewable energy. Such locally driven approaches are supported by the Covenant of Mayors. The Covenant of Mayors is the mainstream European movement involving local and regional authorities in the fight against climate change. It is based on a voluntary commitment by signatories to meet and exceed the EU 20% CO2 reduction objective through increased energy efficiency and development of renewable energy sources[215] .It brings together thousands of local and regional authorities voluntarily committed to implementing EU climate and energy objectives on their territory. Signatories now pledge through their sustainable energy action plans to reduce CO_2 emissions by at least 40% by 2030. Similarly, innovation and integration of ICT, energy and transport solutions at city level is facilitated by the Smart Cities and Communities Partnership[216]. The Partnership aims to overcome bottlenecks impeding the changeover to smart cities, to co-fund demonstration projects and to help coordinate existing city initiatives and projects, by pooling its resources together.

2.5. Conclusion on external coherence

To conclude the EPBD is found coherent with other EU initiatives, which are generally complementary. A coherent, integrated and efficient implementation of EPBD together

[214] Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 concerning measures to reduce the cost of deploying high-speed electronic communication networks

[215] http://www.covenantofmayors.eu/index_en.html

[216] http://ec.europa.eu/eip/smartcities

with other related policies, regulations and standards in EU is possible but implies considering the multi-dimensional based concept of buildings' "efficiency" which encompasses socioeconomic, energy, health, safety of constructions and sustainability aspects while considering national peculiarities and constraints (economic, social, cultural, climatic).

Annex 13 EVALUATION OF THE EU ADDED VALUE

Climate change, security of energy supply and environmental protection are challenges that cannot be sufficiently addressed at national level only. Energy efficiency and on-site renewables in buildings provide part of the solution of these problems and the instruments that have already been adopted at EU level reflect this need for EU action.

The principles of subsidiarity and proportionality were considered by the co-legislators and are explicitly mentioned in the recitals of the EPBD and were carefully respected. The main, predominant objectives of the initiative being to contribute to ensuring security of energy supply in the Union and to promote energy efficiency, delivering cost-effective greenhouse gas emission reductions, Article 194 TFUE (the legal basis of the EPBD) remains appropriate. More generally, EU intervention on energy efficiency of buildings expanded prudently, only where it was justified and leaving significant flexibility to Member States.

Before the adoption of the Directive 2002/91/EC, many Member States did not have energy efficiency requirements or promotional instruments in their regulation and building codes. As a result of Directive 2002/91/EC and EPBD, all Member States have now energy efficiency requirements related to existing and new buildings in their building codes. Prior to the recast, only a few Member States fixed their levels of minimum performance requirements based on cost-optimal solutions, following an assessment of economic impacts[217]. The use of cost-optimality calculations to set minimum performance requirements for energy efficiency and renewable energy measures at cost-efficient levels is now common place in all but one Member State.

The setting of minimum requirements is part of the ex-ante conditionality provisions in the context of the Multi-Annual financial Framework[218], set up to ensure that EU funding is focused on results and creates strong incentives for Member States to ensure the effective delivery of Europe 2020 objectives and targets through Cohesion policy.

1. Relevance for the internal market of harmonisation in this sector

Although the building market, especially the housing market, is generally local and buildings are stationary, some elements of the value chain are increasingly European and global. Construction products and services and the heating, air-conditioning and lighting devices, as well as on-building renewable systems, smart controls, building automation systems, smart meters, etc, are important part of the internal market.

With the increasing mobility of people and number of businesses with operations across the EU, the everyday activities of many people and businesses are not limited to a single country. Increasing the rate of renovation and the quality of buildings (resulting therefore in increased sales of insulation materials, doubled and triple glazed windows, on-building renewable systems, etc) would have a positive effect across the related business sectors.

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[217] Communication Staff Working Document of 13 November 2008 accompanying the proposal for a recast of the EPBD – Impact assessment SEC(2008)2864

[218] Regulation (EU) No 1303/2013 of the European Parliament and the Council of 17 December 2013 laying down common provisions on the ERDF, the ESF, the CF, the EARFD and the EMFF and laying down general provisions on the ERDF, the ESF, the CF and the EMFF and repealing Council Regulation (EC) No 1083/2006, O.J., L 347, 20.12.2013, p. 320)

In addition, with the increasing number of Europeans that live in a country other than their native one and companies that have their businesses activities across the EU, similar ways to measure the energy performance of the buildings they rent or buy would mean a significant decrease of administrative burden. Not surprisingly, requests for more unified and comparable methods come from owners of service-providing chains (such as supermarkets or hotels) and from construction materials and products manufacturing industries.

2. Facilitation of the cooperation amongst regulators

Despite differences in building typologies, local and climatic conditions, national regulators face similar challenges to improve the energy performance of their buildings. Cooperation between regulators is needed to share best practises and foster progress. The EU intervention has proven to be crucial, particularly to create a shared understanding with coherent and valid data, and a comparable level of ambition.

Addressing the energy efficiency in the building sector is a global challenge. While countries have different building code requirements, they face common challenges in improving the energy performance of their buildings. Several international initiatives[219] recently provided evidence of the benefits that international collaboration can bring through sharing of policy best practices, improvement of analytical capabilities, and provision of other resources that accelerate and maximise the benefits of energy efficiency, increase the cost-effectiveness of implemented building related policies, and help bring new technologies to market.

This is confirmed by experience with the Concerted Action EPBD initiative that was initiated by the European Commission in 2005 to promote dialogue and exchange of best practice between the EU Member States. A third phase, from 2011 to 2015, recently delivered its report[220] and the fourth phase has just started.

The EU common framework to establish cost-optimal minimum performance requirements already showed benefits, as the assessment of cost-optimal performance requirements revealed significant cost effective potential in half of the EU Member States[221].

The EU ambition for nearly zero-energy buildings is probably the main area that stakeholders appreciate for its EU added value[222]. The requirement for NZEBs supports a joint approach towards more energy efficient new buildings and comparable ambition levels for highly performing buildings. NZEB targets function as a benchmark to create a better impulse towards achieving energy and climate targets. The best evidence for its added value is the claim for a similar signal to be set at EU level to address the existing buildings stock.

219 IPEEC, 2014, Building Energy Efficiency – Opportunities for International Collaboration;
UNECE, 2015, Outcomes of the survey on building standards and regulation in the UNECE Region.

220 Implementing the Energy Performance of Buildings Directives, 2016, Concerted Action EPBD

221 Assessment of cost-optimal calculations in the context of the EPBD, 2015, European Commission (written by Ecofys)

222 Public Consultation on the Evaluation of the EPBD – Final synthesis report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

3. International leadership in standardisation

More harmonised approaches open wider markets for innovative products, enabling cost reduction. Following the adoption of Directive 2002/91/EC, the European Commission issued a mandate[223] to CEN for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings. This work resulted in the adoption and publication of 42 European Standards, including 11 ISO standards.

On 14 December 2010, the European Commission issued a new mandate[224] to review this first set of standards so that they become, on the one hand unambiguous and compatible, and on the other hand a clear and explicit overview of the choices, boundary conditions and input data that need to be defined at national or regional level. On the basis of this work, ISO reserved the ISO 52000 series of standards, with positive outcomes on the public enquiry on the overarching standard DIS 52000-1 integrating the final energy performance calculation, both at CEN and ISO level.

Mirroring Eurocodes'[225] approach for structural and safety requirements, the set of standards currently developed by CEN for an integrated calculation of the energy performance of buildings can be a tool for accelerating the process of convergence of different national and regional regulatory approaches and for fostering the global competitiveness of the European construction enterprises, beyond the borders of the European Union.

4. Support to financing in the energy performance of buildings

In addition to EU-level action regarding national EPC schemes, specific EU added value is seen by property and portfolio managers in the voluntary common scheme for the certification of non-residential buildings to facilitate swift comparison of international properties and investments (e.g. in renovation). This voluntary common scheme, currently under development in line with Article 11(9) of the EPBD, will be underpinned by the updated EPBD standards. EU action is needed to allow for a reliable comparison of buildings' energy use across borders, particularly relevant for market participants in the non-residential sector.

Financial institutions[226] also gave clear indications that the efforts to increase of public and private investments' effectiveness and contribute to the further development of appropriate and attractive financing products on the market are needed at both national/local and EU level. Standardisation and improvement of buildings certification and open source EU Buildings energy database (i.e. the EU Building Stock Observatory) are needed to facilitate the financing and refinancing of energy efficiency investments.

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223 Mandate M/343 of 30 January 2004 or a methodology calculating the integrated energy performance of buildings and estimating the environmental impact.

224 Mandate M/480 of 14 December 2010 for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting the energy efficiency of buildings, in accordance with the terms set in the recast EPBD.

225 State of implementation of the Eurocodes in the EU, 2015, European Commission (JRC)

226 Energy Efficiency Financial Institutions Group, "Energy Efficiency – the first fuel for the EU Economy. How to drive new finance for energy efficiency investments", February 2015, www.eefig.eu

5. Better data for better policies and smarter financing

The importance of robust data is a pre-requisite to address the EU global challenge of a decarbonised building stock. Although not the last in class at global level, the EU was flagged to have weaknesses in data quality, behind the US, in particular for the services sector[227]. There is still lack of data to completely understand the interplay of the different factors, and in particular the specific contribution of improvement of the EU buildings stock in the moderation of energy consumption. In that context, the additional data collection initiated by Eurostat for households will not completely fill the gap and EU action is needed to gain better data on building stocks, starting with the completion of the EU Building Observatory in 2016.

Responses to the public consultation and EEFIG Report widely acknowledge that further EU-level harmonisation and guidance concerning methods for data collection, data analysis and protocols for data sharing are, e.g. an indispensable prerequisite for aggregation of small scale projects and development of attractive financial products[228].

In particular, the role that the EU can play to encourage Member States to open their national EPC databases to the public and then to aggregate a selection of these data in a user-friendly manner[229] was identified. Some Member States (e.g. Denmark, Estonia, Hungary, Ireland, Lithuania, the Netherlands, Portugal, Sweden, parts of the United Kingdom-England and Wales, and Norway) provide open access to selected EPC information directly from these database. EPCs have the potential to be important sources of initial information on the energy performance of the EU building stock and positively influence renovation measures[230].

The market for energy efficiency investments in buildings is still fragmented with multitude of small scale transactions. It needs to mature and grow. The above-mentioned performance data standardisation approaches on the (finance) demand side must therefore be accompanied by the development of a common framework for underwriting procedures on the (finance) supply side, allowing for industrialisation of this (so far) niche market. As highlighted in the EEFIG Report, the EU has a role to play in making this development in line with the policy objectives and targets, ensuring consistency and transparency. This work will therefore form a key element of Smart Finance for Buildings Initiative.

6. Research and innovation

The construction industry also gave a clear indication[231] that energy efficiency in the built environment cannot be solved on an individual Member State scale. Leveraging at EU scale and customisation at local scale are both needed.

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227 Robust building data: A driver for policy development, 2013, GBPN

228 Energy Performance Certificates across the EU. A mapping of national approaches, Buildings Performance Institute Europe (BPIE), 2014; and
European Energy Performance of Properties Analysis (EEPPA). Supporting the development of an overachring European Energy Performance Certificate. 2013, Climate Knowledge and Innovation Communities (Climate-KIC)

229 Public Consultation on the Evaluation of the EPBD – Final synthesis report, 2015, European Commission (written by Ecofys) https://ec.europa.eu/energy/sites/ener/files/documents/MJ-02-15-954-EN-N.pdf

230 EPCs across the EU, 2014, BPIE

231 Energy-efficient buildings – Multi-annual roadmap for the contractual PPP under Horizon 2020, 2013, European Commission

By offering solutions and possibilities that better respond to market's needs, future technological developments and research and innovation represent an opportunity to further underpin the implementation of EU policies and accelerate the transformation of our buildings. In particular, the market is looking for technologies and solutions which are less costly, easier to install and use, more compatible with existing equipment and systems, more reliable in their performance, more energy efficient or which provide additional benefits to occupants and increase their quality of life (e.g. thermal comfort, acoustic, lighting, air quality improvements). The development of such solutions needs to be driven by a system-based approach where buildings are considered as an overall system of combined technologies working together while respecting health-based criteria and requirements, e.g. building envelope (walls, doors, windows and the roof), heating and cooling systems.

Significant EU public funds have already been directed to research activities for energy efficiency in buildings within Horizon 2020. This includes a public-private partnership on Energy Efficient Buildings where industry participation exceeds 50 % with SMEs involvement at the level of 30 %. Support will also come from the European Structural and Investment Funds (ESIF)[232]. Smart Specialisation Strategies, which are a pre-condition for ERDF funding for research and innovation, identify key investment priorities for Member States and regions. Energy is one of the most widely chosen priorities. The Commission in 2015 launched a platform to assist Member States and regions in the uptake of the Cohesion Policy funds[233] for sustainable energy, including for research and innovation[234]. The innovative technologies needed to boost energy efficient buildings are unlikely to be commercially available as quickly as is desirable especially for buildings renovation. Further EU wide public intervention is needed to avoid market failures. Public intervention allows investigating innovative solutions, thus giving industry more options to address economic scenarios over a long period of time (2020-2050).

In line with the fifth dimension of the Energy Union, the Strategic Energy Technology (SET) Plan will play a key role in prioritising our research and innovation activities at an EU level. The development of new materials and technologies for making our building stock more energy efficient is one of the ten actions identified to accelerate the energy system's transformation and create jobs and growth in Europe. As a result, the SET Plan should lead to more research and innovation cooperation and coordination across the EU and lead to synergies among Member States and market actors.

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232 ESIF include the European Regional Development Fund (ERDF), the Cohesion Fund (CF), the European Social Fund (ESF), the European Agricultural Fund for Rural Development (EAFRD), and the European Maritime and Fisheries Fund (EMFF).

233 Cohesion Policy funds include the ERDF, CF and ESF.

234 http://s3platform.jrc.ec.europa.eu/s3p-energy